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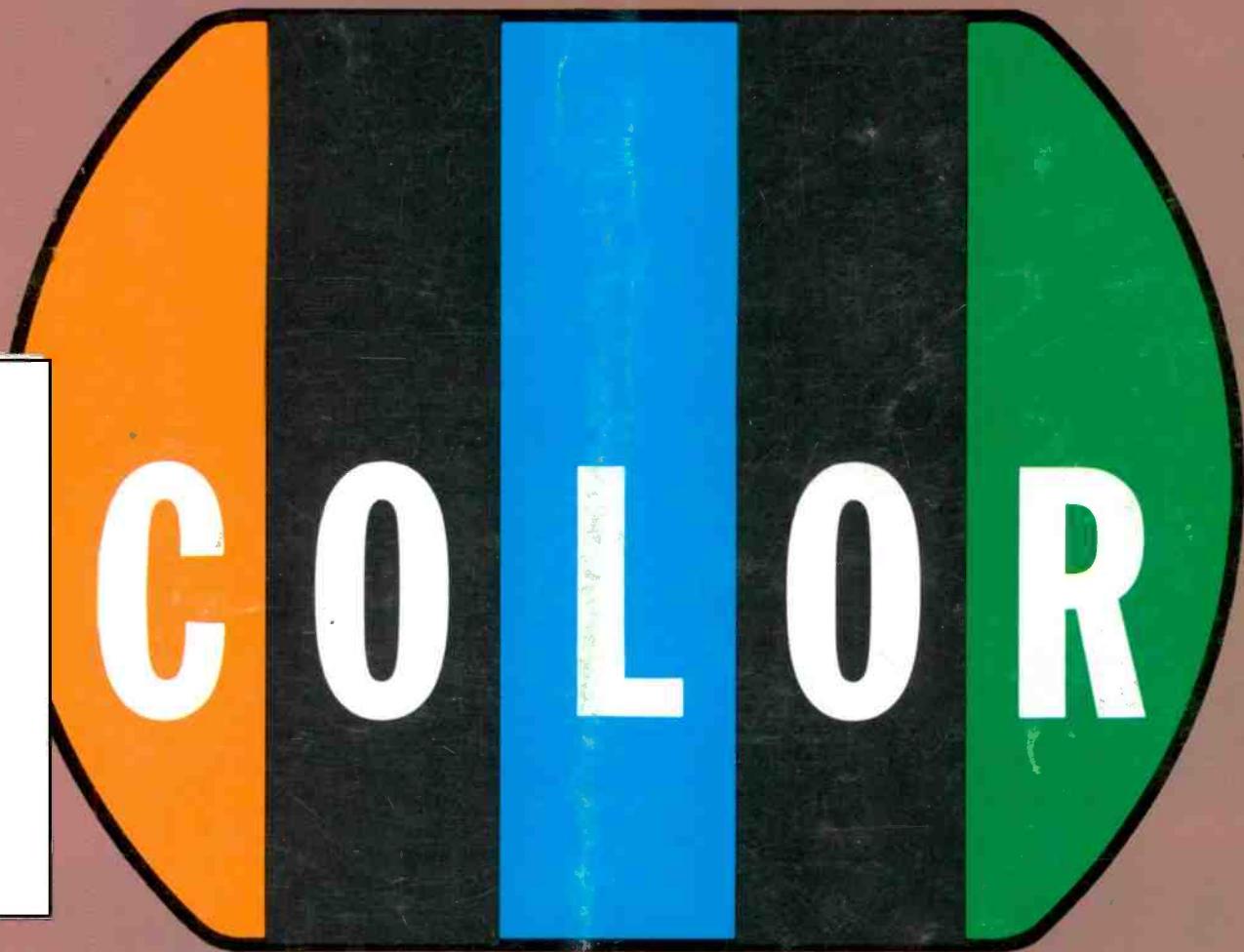


A HOWARD W. SAMS PUBLICATION

# Electronic Servicing

Formerly PF Reporter

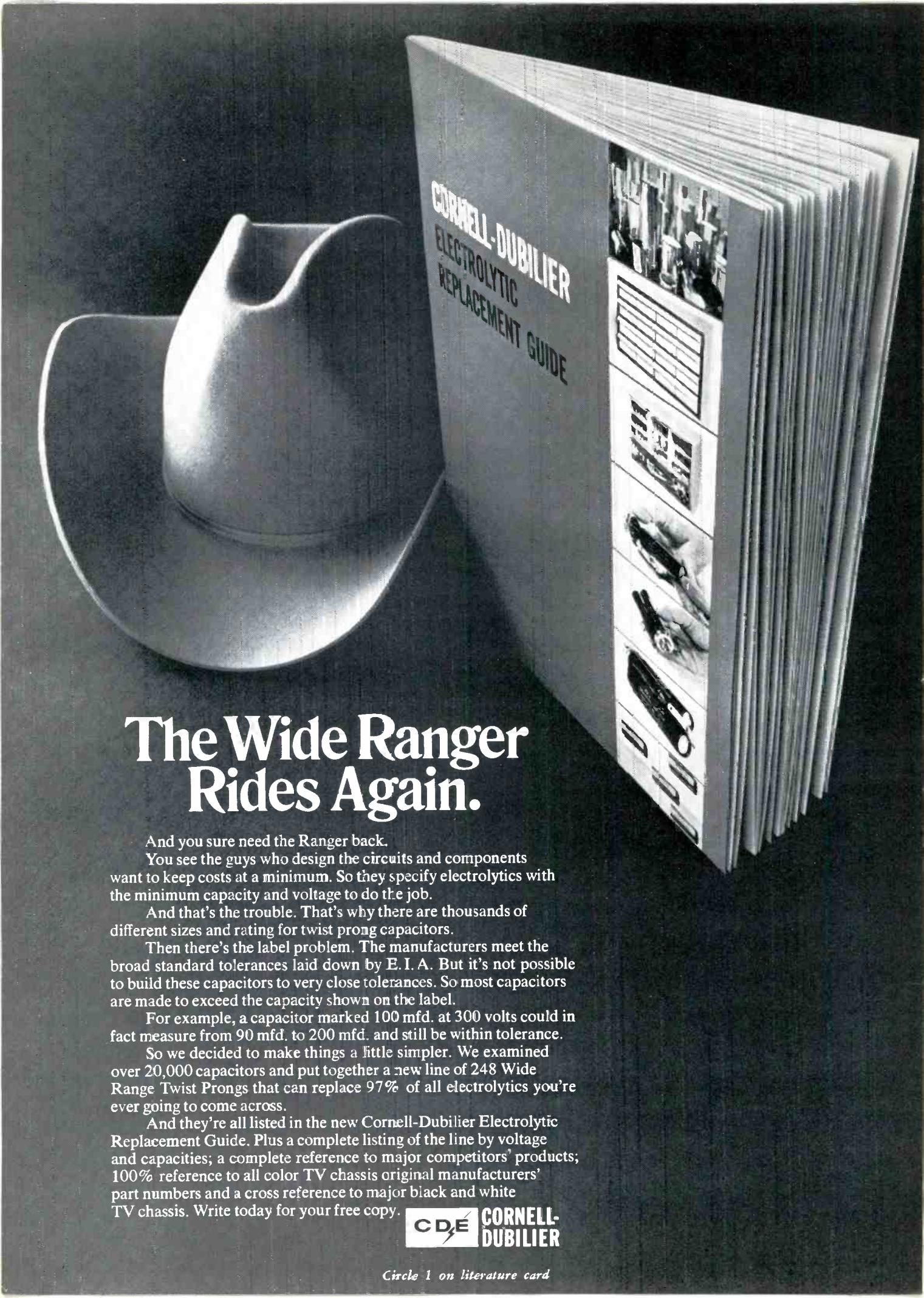
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CORNELL-DUBILIER  
ELECTROLYTIC  
REPLACEMENT GUIDE

# The Wide Ranger Rides Again.

And you sure need the Ranger back.

You see the guys who design the circuits and components want to keep costs at a minimum. So they specify electrolytics with the minimum capacity and voltage to do the job.

And that's the trouble. That's why there are thousands of different sizes and rating for twist prong capacitors.

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For example, a capacitor marked 100 mfd. at 300 volts could in fact measure from 90 mfd. to 200 mfd. and still be within tolerance.

So we decided to make things a little simpler. We examined over 20,000 capacitors and put together a new line of 248 Wide Range Twist Prongs that can replace 97% of all electrolytics you're ever going to come across.

And they're all listed in the new Cornell-Dubilier Electrolytic Replacement Guide. Plus a complete listing of the line by voltage and capacities; a complete reference to major competitors' products; 100% reference to all color TV chassis original manufacturers' part numbers and a cross reference to major black and white TV chassis. Write today for your free copy.



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# KAY-TOWNES

OVER 1,000 MODELS — AREA CUSTOM DESIGNED AND PRIVATE LABELED

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UHF-VHF

BEST  
BECAUSE IT'S

# "COLOR-TUNED"

FOR PERFECT COLOR RECEPTION

RAIN OR SHINE!



**5** FIELD TESTED AND PROVEN MODELS  
FOR EVERY RECEPTION NEED

CT-42G, 34G, 30G, 24G, 18G  
WITH FREE BAND SPLITTER

CT-42G

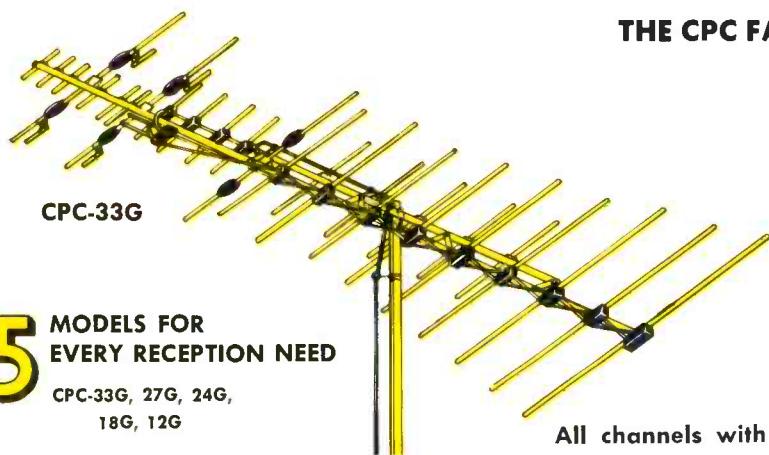
GET A BETTER PICTURE FROM ANY SET — COLOR OR BLACK AND WHITE — WITH A KAY-TOWNES ANTENNA

## THE CPC FAMILY

82 CHANNEL UHF-VHF

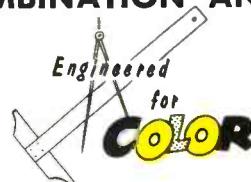
# colorphase

COMBINATION ANTENNA



**5** MODELS FOR  
EVERY RECEPTION NEED

CPC-33G, 27G, 24G,  
18G, 12G



All channels with single download      FREE BAND SPLITTER

GET A BETTER PICTURE FROM ANY SET — COLOR OR BLACK AND WHITE — WITH A KAY-TOWNES ANTENNA

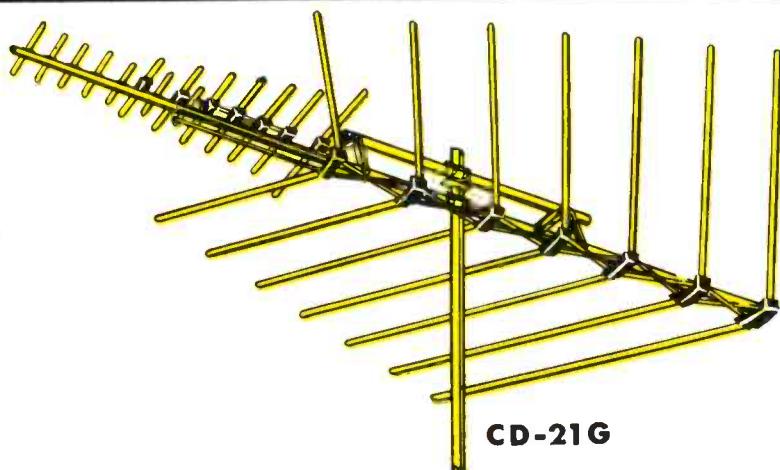
## THE CD FAMILY

82 CHANNEL  
UHF-VHF-FM COMBINATION  
WITH FREE BAND SPLITTER

# colorDyne

**4** MODELS FOR EVERY  
RECEPTION NEED

CD-21G, 19G, 13G, 11G



CD-21G

SEE THEM AT THE LAS VEGAS SHOW — BOOTHS E-115-117

**KAY-TOWNES antenna co.**

P. O. BOX 593 • ROME, GA. 30161 (404) 235-0141

Circle 2 on literature card

May, 1969/ELECTRONIC SERVICING 1

# Electronic Servicing

**Formerly PF Reporter**

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**24 Troubleshooting Color Video Amplifiers.** Defects that cause poor picture quality—trouble symptoms, and techniques for isolating their causes. by Bruce Anderson.

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Robert E. Hertel, Publisher

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# OVERHAUL

# \$9.75

## GUARANTEED for 1 Year

**OVERHAUL \$9.75**

**• REPLACEMENT TUNERS...\$10.45**

Nine-seventy-five buys you a complete tuner overhaul—including parts (except tubes or transistors)—and absolutely no hidden charges. All makes, color or black and white. UV combos only \$15.

Guaranteed means a full 12-month warranty against defective workmanship and parts failure due to normal usage. That's 9 months to a year better than others. And it's backed up by the only tuner repair service authorized and supervised by the world's largest tuner manufacturer—Sarkes Tarzian, Inc.

Four conveniently located service centers assure speedy in-and-out service. All tuners thoroughly cleaned, inside and out . . . needed repairs made . . . all channels aligned to factory specs, then rushed back to you. They look—and perform—like new.

SEND ORDERS FOR UNIVERSAL AND CUSTOMIZED REPLACEMENT TUNERS TO OUR OFFICE IN INDIANAPOLIS.



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SOUTH-EAST	938 GORDON ST., S. W., Atlanta, Georgia	TEL: 404-758-2232
WEST	SARKES TARZIAN, Inc. TUNER SERVICE DIVISION 10654 MAGNOLIA BLVD., North Hollywood, California	TEL: 213-769-2720

**WATCH FOR NEW CENTERS UNDER DEVELOPMENT**

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To service Color TV you need:

1. vectorscope
  2. color bar generator
- and you can't  
use one without  
the other!**



One Year  
Warranty

## only the V7 gives you both

- The only complete one unit color vectorscope/color-bar generator available anywhere!
- Completely portable for servicing color TV in the home . . . no need to bring set to the shop!
- The only one with detailed instructions on color circuit alignment and color adjustment. And, additional instructions are available as new sets are introduced!
- Recommended by leading TV manufacturers!
- Proven performance . . . over 4 years of use in field and shop by thousands of technicians . . . no other vectorscope manufacturer can make this claim!

**V7**

- Checks and aligns demodulators to any angle.
- Checks and aligns bandpass-amplifier circuit.
- Pinpoints troubles to a specific color circuit.

**Exclusive Features:** Self-Calibrating—adjust timing circuit without external test equipment, Dial-A-Line—adjust horizontal line to any width from 1 to 4. Plus: All Crosshatch, Dots, and Color Patterns; Voltage Regulated; Fully Enclosed Cable Compartment. Free copy of Wayne Lemon's Book, "Color TV Servicing Simplified with Vectorscope".

Net **18950**

Remember . . . V7—the complete one

See your distributor or write Dept. ES 5

**LECTROTECH, INC.**  
4529 N. Kedzie Ave., Chicago, Ill. 60625  
Circle 4 on literature card

# electronic scanner

news of the industry

### Pennsylvania Federation Urges Attendance at Eastern Conference

The Federation of Radio-Television Service Associations of Pennsylvania, Inc. has invited "all servicing associations and all those interested in the welfare of the electronic service industry" to participate in the Eastern Service Conference of their association to be held May 9 through May 11 at the Bellevue Stratford Hotel in Philadelphia.

The purpose of the conference is "to gather the service representatives and interested persons from all Eastern states to formulate a policy or program which will be presented to representatives of other segments of the electronic industry who will be present at this conference."

### Three New Sylvania Color CRT's Scheduled for 1970

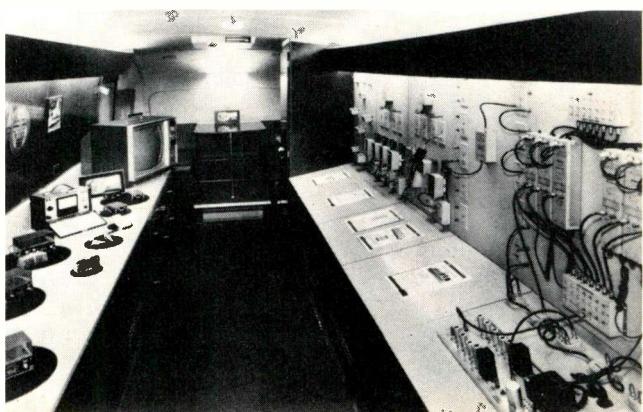
Plans for the introduction in 1970 of three new color television tube types has been announced by the Electronic Tube Division of Sylvania Electric Products, Inc.

The new tubes are a 25-inch viewable, 90-degree, square-corner type; a 21-inch viewable, 90-degree, square-corner type; and an 18-inch viewable, 110-degree type.

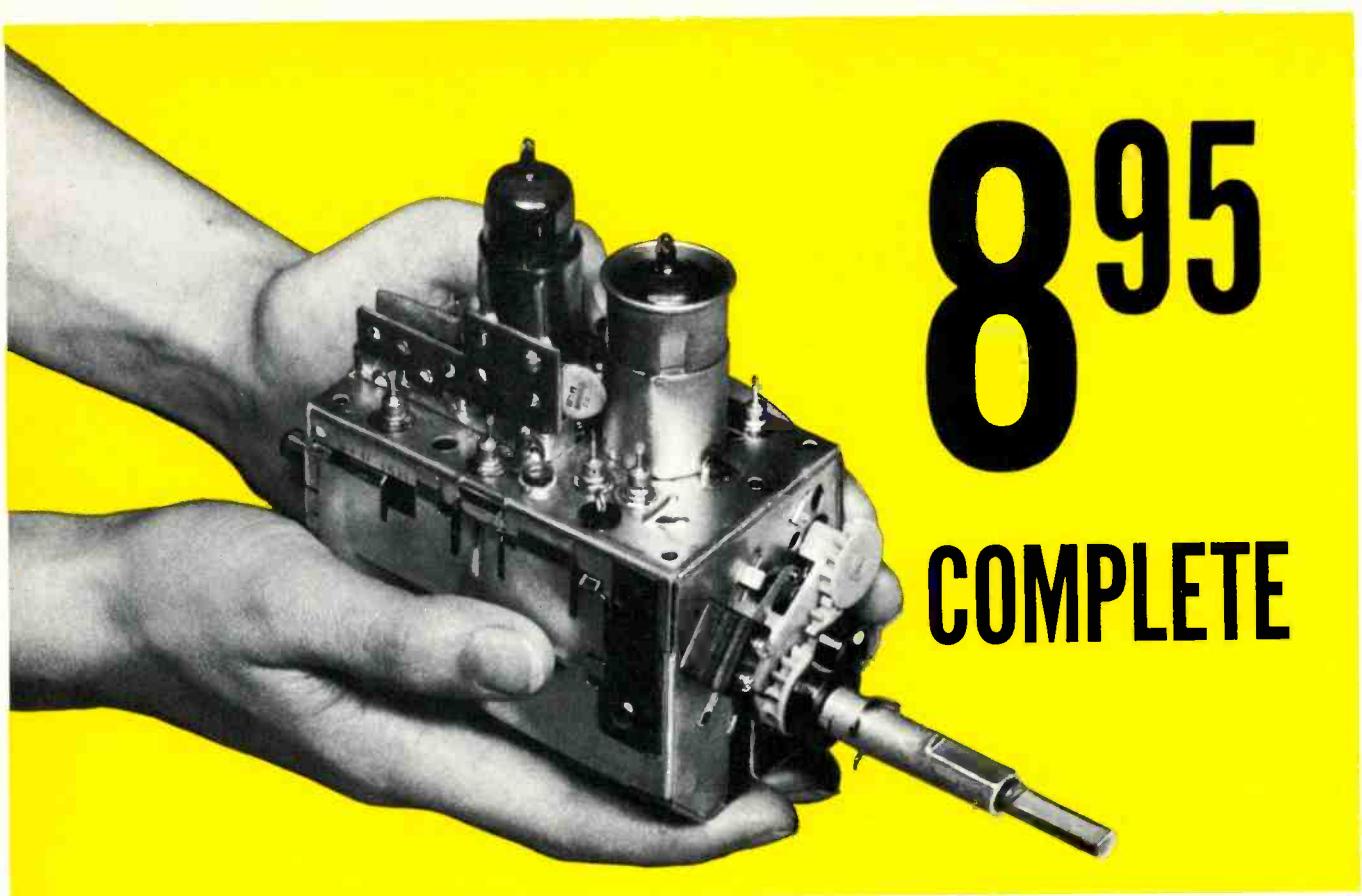
### MATV Mobile Display Unit Begins National Tour

A thirty-foot, self-contained, mobile display and research laboratory operated by The Finney Company, Bedford, Ohio, has begun a national tour that will eventually include all fifty states.

The purposes of the mobile unit include the demonstration of MATV system components, system design techniques and the researching and solving of individual problems that might arise in the actual installation of an MATV system.



# 895 COMPLETE



**Castle, the pioneer of television tuner overhauling, offers the following services to solve ALL your television tuner problems.**

● **OVERHAUL SERVICE** — All makes and models.

VHF or UHF tuner	\$9.95
UHF-VHF combination (one piece chassis)	\$9.95
TRANSISTOR tuner	\$9.95
COLOR tuner (Guaranteed color alignment . . . no additional charge)	\$9.95

Overhaul includes parts, except tubes and transistors.

Simply send us the defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. Your tuner will be expertly overhauled and returned promptly, performance restored, aligned to original standards and warranted for 90 days.

UV combination tuner must be single chassis type; dismantle tandem UHF and VHF tuners and send in the defective unit only.

And remember—for over a decade Castle has been the leader in this specialized field . . . your assurance of the best in TV tuner overhauling.

● **CUSTOM REPLACEMENTS**

Exact replacements are available for tuners that our inspection reveals are unfit for overhaul. As low as \$12.95 exchange. (Replacements are new or rebuilt.)

● **UNIVERSAL REPLACEMENTS**

Prefer to do it yourself?

Castle universal replacement tuners are available with the following specifications.

STOCK No.	HEATERS	SHAFT		I.F. Snd.	OUTPUT Pic.	PRICE
		Min.*	Max.*			
CR6P	Parallel 6.3v	1 3/4"	3"	41.25	45.75	8.95
CR7S	Series 600mA	1 3/4"	3"	41.25	45.75	9.50
CR9S	Series 450mA	1 3/4"	3"	41.25	45.75	9.50
CR6XL	Parallel 6.3v	2 1/2"	12"	41.25	45.75	10.45
CR7XL	Series 600mA	2 1/2"	12"	41.25	45.75	11.00
CR9XL	Series 450mA	2 1/2"	12"	41.25	45.75	11.00

\*Selector shaft length measured from tuner front apron to extreme tip of shaft.

These Castle replacement tuners are all equipped with memory fine tuning, UHF position with plug input for UHF tuner, rear shaft extension and switch for remote control motor drive . . . they come complete with hardware and component kit to adapt for use in thousands of popular TV receivers.

Order universal replacements out of Main Plant (Chicago) only.

**CASTLE TV TUNER SERVICE, INC.**

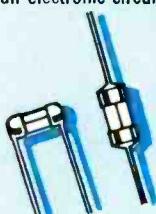


**MAIN PLANT:** 5701 N. Western Ave., Chicago, Illinois 60645  
**EAST:** 41-90 Vernon Blvd., Long Island City, N.Y. 11101

*Circle 5 on literature card*

## SUB-MINIATURE FUSES

Ideal for space tight applications, light weight, vibration and shock resistant. For use as part of miniaturized integrated circuit, large multi-circuit electronic systems, computers, printed circuit boards, all electronic circuitry.



### TRON Sub-miniature Pigtail

**Fuses** — Body size only .145 x .300 inches. Glass tube construction permits visual inspection of element. Hermetically sealed. Twenty-three ampere sizes from 1/100 thru 15.



### BUSS Sub-miniature GMW

#### Fuse and HWA Fuseholder

Fuse size only .270 x .250 inches. Fuse has window for visual inspection of element. Fuse may be used with or without holder. 1/200 to 5 amp. Fuses and holders meet Military Specifications.

*Write for BUSS Form SFB*

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# BUSS QUALITY

FUSES

BUSSMANN MFG. DIVISION, McGraw-Edison Co. St. Louis, Mo. 63107

## BUSS: The Complete Line of Fuses and . . .

### TEA Licensing Survey

The Texas Electronics Association (TEA) recently conducted a survey to determine how service technicians in their state feel about licensing of electronic technicians.

700 technicians, including members and non-members of their association, were sampled. Of 322 responses, 90 percent (270) were in favor of licensing. Of the remaining 52 respondents, 31 were against licensing and 21 were undecided.

Also, the majority of those responding to the survey indicated that they were in favor of the "grandfather" clause, which exempts from initial examination those technicians who are currently actively engaged in the electronic servicing business. A majority of those responding also indicated they were against periodic re-examination.

—New York TSA Newsletter

### Admiral Appoints Chicago Service Manager

Harold G. Mowbray has been appointed general service manager of the Chicago Division of the Admiral Corporation.

Located in Rosemont, a suburb of Chicago, the Chicago distributing division covers the greater Chicago area plus parts of Indiana.

### Imported TV on Upswing

Japanese television imports into the U.S. increased 54.7 percent in 1968, according to the Tube Imports Committee of the Electronics Industry Association (EIA). Actual shipments during an 11-month period in 1968 included 1,604,000 black-and-white and 660,000 color television receivers.

During the same period of time, U.S. production of televisions increased by only 3 percent.

According to another EIA report, total U.S. sales of imported TV sets amounted to 1.5 million units, or about 11 percent of the total U.S. television market. U.S. sales of imported TV in 1967 accounted for 6 percent of the total television sales.

### NATESA Award Goes to Howard W. Sams & Co. for 16th Year

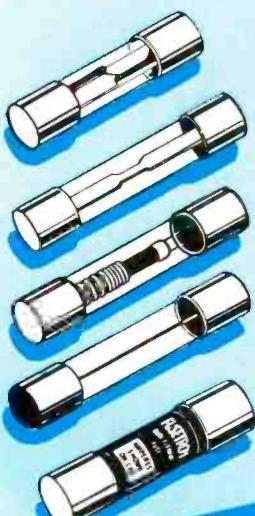
Howard W. Sams & Company, Inc., Indianapolis, has received the Friends of Service Management Award from the National Alliance of Television & Electronic Service Associations (NATESA) for the sixteenth consecutive year.

The awards are presented to companies with records of outstanding contributions to the electronics industry.

Presentation of the award was made to William J. Laird, president of the Howard W. Sams Company, by Clifford A. Shaw, president of NATESA.

### THE COMPLETE LINE OF Small Dimension FUSES

*For The Protection of All Types of Electronic and Electrical Circuits and Devices . . .*



. . . includes dual-element "slow-blowing", single-element "quick-acting" and signal or visual indicating types . . . in sizes from 1/500 amp. up.

For special fuses, clips, blocks or holders, our staff of fuse engineers is at your service to help in selecting or designing the fuse or fuse mounting best suited to your requirements.

*Write for BUSS Form SFB*

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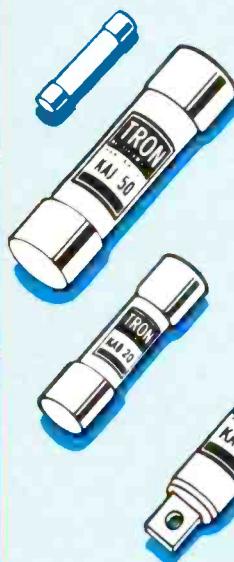
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BUSSMANN MFG. DIVISION, McGraw-Edison Co. St. Louis, Mo. 63107

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## The Complete Line of Fuses For The Protection of Semi-Conductor Rectifiers



### TRON Rectifier Fuses

Provide extremely fast opening on overload and fault currents, with a high degree of restriction of let-thru current. Many types and sizes available. Ampere ratings from  $\frac{1}{2}$  to 1000 in voltage ratings up to 1500.

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# BUSS QUALITY

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BUSSMANN MFG. DIVISION, McGraw-Edison Co. St. Louis, Mo. 63107

## Fuseholders of Unquestioned High Quality

### IC VHF Tuner

An integrated-circuit (IC) tuner for VHF monochrome and color television has been developed jointly by Oak Electronetics Corp., Crystal Lake, Illinois, and Murata Manufacturing Co., according to a recent report in **Home Furnishings Daily**.

The report stated that the new tuner has been made possible by combining a hybrid IC (containing approximately 50 transistors and capacitors) with a printed coil and switch. The module is reported to be about the size of a match box, or  $\frac{1}{3}$  inch by  $1\frac{1}{2}$  inches.

Production and export to the U.S. is expected to begin later this year.

### NEA Board of Directors to Meet in Philadelphia

The quarterly Board of Directors meeting of the National Electronic Associations (NEA) will be held on May 9 and 10 at the Bellevue Stratford Hotel in Philadelphia, Pa.

According to Leon F. Howland, secretary of NEA, the date and place of the quarterly meeting was chosen to allow NEA state leaders to accept an invitation to attend the Eastern Conference of the Federation of Radio-Television Service Associations of Pennsylvania which is to be held in Philadelphia May 9 through May 11.

Total 1968 U.S. Sales of Radio and TV  
(From Electronics Industry Association Report)

Product	Total Sales
Television	6,997,859
Monochrome TV	6,213,347
Color TV	
Total TV	13,211,206
Radio	
Home radio	34,322,299*
Auto radio	12,509,841
Total radio	46,832,140

\*Excluding TV/radio/Phono Combinations

### NEA Annual Convention

The 5th annual national convention of the National Electronic Associations (NEA) will be held July 23 to July 27 at the Quality Courts Motel in Waterbury, Connecticut.

This year, for the first time, the NEA annual convention will feature service seminars held by antenna, test equipment and consumer electronic product manufacturers.

TELSEA of Connecticut is the sponsoring state association. Mr. George Dukes, 100 Larchmont Ave., Waterbury, is the convention chairman. ▲

## The Complete Line of Signal-Indicating Alarm-Activating Fuses

For use on computers, microwave units, communication equipment, all electronic circuitry.



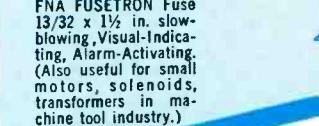
BUSS GBA-1/4 x 1/4 in.  
Visual-Indicating.



BUSS MIN-13/32 x 1 1/2 in.  
Visual-Indicating.



BUSS ACH  
Aircraft Limiter,  
Visual-Indicating.



FNA FUSETRON Fuse  
13/32 x 1 1/2 in. slow-  
blowing, Visual-Indica-  
ting, Alarm-Activating.  
(Also useful for small  
motors, solenoids,  
transformers in ma-  
chine tool industry.)



BUSS Grasshopper  
Fuse, Visual-Indicating,  
Alarm-Activating.



BUSS GMT and HL-T  
holder, Visual-Indica-  
ting, Alarm-Activating.

*Write for BUSS Form SFB*

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Circle 7 on literature card

# letters to the editor

## Letter of Agreement

I agree completely with most of the points Mr. Wolven made in his letter in the "Letters to the Editor" column in the February ELECTRONIC SERVICING . . .

We here on Vancouver Island, British Columbia, now enjoy government ticketed protection before one can work as an electronic technician. I used the word "enjoy" in a frivolous sense because this is what it amounts to.

Local electrical tradesmen are paid over \$5.00 per hour. The highest-paid TV technician is lucky if he can make \$3.00 per hour.

At these rates and prices, independent service is here to stay—as long as manufacturers can have such cheap service.

H. Alexander  
Victoria, British Columbia

## 1619 Tube and Imported Sets Info

Mr. Abrams ("Letters to the Editor," March issue), the 1619 tube is listed in "the special purpose tubes" section of most electronics catalogs, including: Allied Radio, Burstein-Applebee and Newark Electronics.

H. A. Middleton's 1st edition Tube Substitution Guide lists a 2A5 as a substitute for a 1619 in parallel circuits (adapter needed). The Arcturus catalog is the only source I've found which lists the 2A5.

In response to the request in the February issue for additional names and addresses of importers or distributors:

### Teppaz

(French-made phonographs)

#### Importer/Distributor:

Benman Company  
North Tonawanda, NY 14120

I obtained this address from the local French consul-general.

I need a catalog or source of supply for metric hardware.

Lyman Waters  
P.O. Box 333  
Dolores, CO 81323

## Article on

### Cassette Auto Stereo Wanted

I would like to see in your magazine an article on the servicing of cassette auto stereo tape players.

At present I am not doing much servicing of such units, but my son claims that quite a few of the high school students are putting them in their cars.

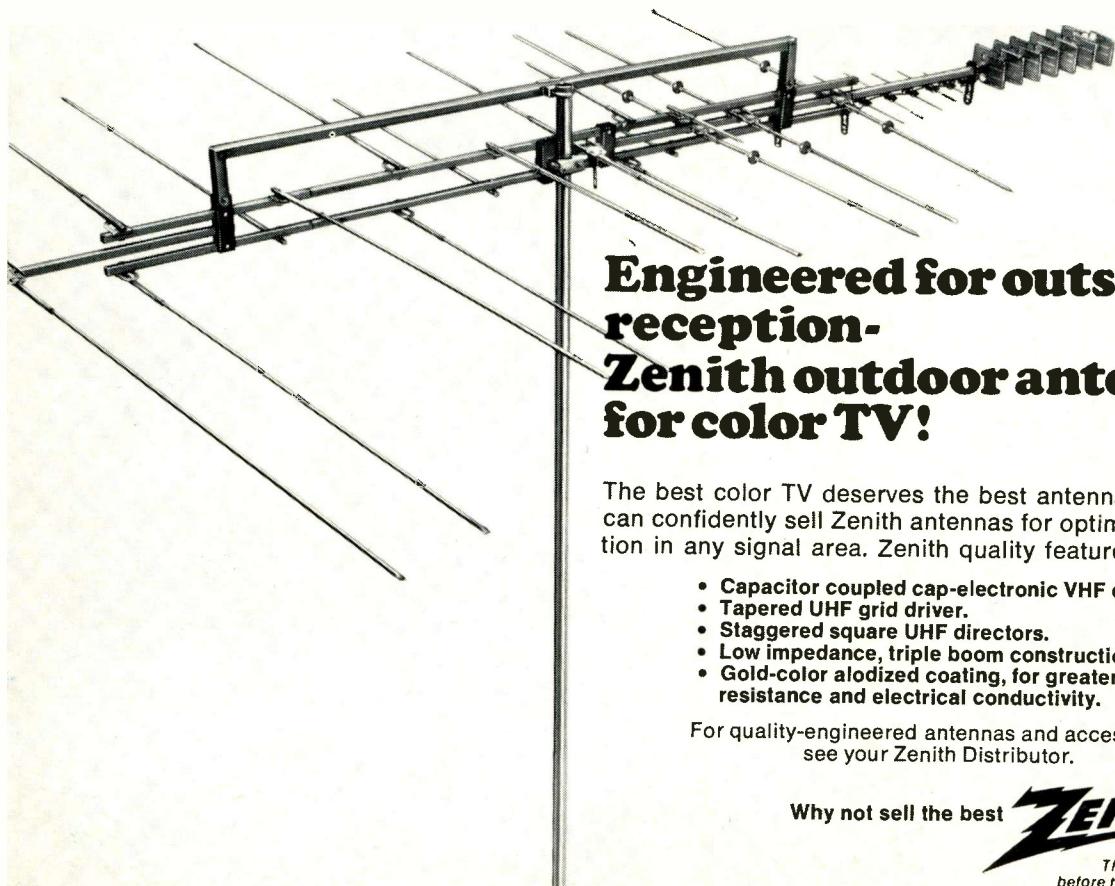
Thank you for your past help on my service problems.

Edward J. Ferraro  
North Bergen, NJ

Mr. Ferraro, beginning in the June issue and continuing each month, electronic technician Allan Dale will discuss, in a department titled "Dale's Service Bench," the practical servicing of a variety of consumer electronic products. The topic of the June installment will be the servicing and operation of motors and governors in auto tape players.

## Paco Found

In the "Letters to the Editor" column in the March issue, Mr. Dalen requested information about Paco Electronics.



## Engineered for outstanding reception— Zenith outdoor antennas for color TV!

The best color TV deserves the best antenna. And you can confidently sell Zenith antennas for optimum reception in any signal area. Zenith quality features include:

- Capacitor coupled cap-electronic VHF dipoles.
- Tapered UHF grid driver.
- Staggered square UHF directors.
- Low impedance, triple boom construction.
- Gold-color alodized coating, for greater corrosion resistance and electrical conductivity.

For quality-engineered antennas and accessories, see your Zenith Distributor.

Why not sell the best

**ZENITH**  
The quality goes in  
before the name goes on

Circle 8 on literature card

Paco was the test-equipment kit division of Precision Apparatus. All of the assets of this discontinued company were bought by Dynascan Corporation, who now handles all requests for parts and service on both Paco and Precision test instruments. Requests should be directed to:

*Precision Apparatus Div.  
Dynascan Corporation  
1801 W. Belle Plaine Ave.  
Chicago, IL 60613  
Lyman Waters  
Dolores, CO*

Thank you, Mr. Waters. Other readers responding to Mr. Dalens request were:

William Misiek, Silver Springs, MD;  
B. D. Harmon, Jr., address not given;  
Alex C. McIntosh, Weirton, WV;  
Nils H. Paquette, Toledo, OH;  
Leon Wedar, Minot, ND.

Many thanks to you gentlemen for assisting a fellow technician.

#### Help Needed

I am having a problem locating a schematic for a Starlite AM-FM radio with a shortwave band from 3.5 MHz to 9 MHz. This set was taken in for repair and I cannot locate a model number, serial number or any other marking that would give me a clue to the model number. The cabinet is 25½" long and contains two speakers. The tube complement consists of two 12DT8's, two 12BA6's, one 12VA6, one 12BE6 and one 50C5. Any help in obtaining a schematic for this radio will be greatly appreciated.

Howard T. Bates  
94-29 210 Street  
Queens Village, NY 11428

Send a description of the unit to the marketer at the following address:

Star-Lite Electronics Corporation  
37 West 23rd St.  
New York, NY 10010

I do not know if Star-Lite is still in business. If they are, they should be able to tell you the model number. If not, perhaps a reader is familiar with this particular brand and will be able to help.

The motor burned out in a Webcor Model 8C1865-1 record player and I have not been able to ob-

tain a replacement. The part number is 17X710-1. Perhaps a reader of ELECTRONIC SERVICING can tell me where I can obtain a replacement motor for the unit.

Vernon Nave  
Box 286  
Crabtree, PA 15624

I have three items of test equipment for which I cannot obtain instruction manuals, or operating handbooks. The instruments are:

1. Tele-Check CRT Test Jig, built by I.E.H. Manufacturing Co. This unit has an 8PY4 CRT and a 110 degree universal yoke.

2. Model 123 Radio City Products flyback yoke and flyback transformer checker.

3. EBCO CRT Checker-Reactivator, manufactured by Electronic Beam Company of Yonkers, NY.

I would appreciate it if someone could advise me where I can obtain any of the above instruction books.

Maurice Schuman  
1773 50th Street  
Brooklyn, NY 11204

I need a circuit diagram and information on two test instruments:

1. Delta Model 10A VTVM.  
2. Lamatron Model 603 trigger rate converter.

I will be glad to pay for copies of the schematics and any other information pertaining to these instruments.

Carmine Lobosco  
2538 Bath Ave.  
Brooklyn, NY 11214

I need a schematic diagram or service manual for a Philco Model 7170 AM-FM signal generator. I have sent a request to the manufacturer in Philadelphia, but was advised that the generator is no longer being marketed and no service manuals are available. If a reader of ELECTRONIC SERVICING has any information or a schematic or manual covering this instrument, I would appreciate hearing from him.

Selwyn Warner  
119-09 Marsden St.  
Jamaica, NY 11434

(Continued on page 12)

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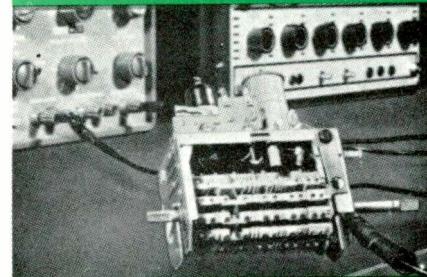
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For years now, B&K has been hailed by service engineers everywhere as the leader in electronic servicing equipment. We like that kind of reputation—and we aim to keep it! But we're realistic. We know that in order to maintain our reputation, we have to do more than just manufacture top-quality test equipment. We know that our diagnostic equipment must not only work flawlessly, but must also stimulate your sales and promote customer confidence in your abilities as a professional service



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engineer. That's why we designed the "Silent Partners."

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Where electronic innovation is a way of life.

### Non-Membership— Non-Involvement

I have no intention of debating with such an obviously intelligent and articulate member of the servicing profession as Mr. Francis Wolven appears to be. However, his letter to the editor in your February issue contains one statement that I can't help but take issue with. At one point, Mr. Wolven states with apparent pride that he can speak objectively because he is

"a non-member of any service organization."

My thoughts are not objective; but I do firmly believe that many of the ills within our profession have been allowed to become entrenched because too many of the otherwise intelligent members of our profession prefer "non-membership" and non-involvement to taking a stand and joining in concerted attempts to preserve and elevate the industry . . .

It could be different.

W. S. Harrison

Virginia Electronics  
Association  
Chesapeake, VA 23325

### Reader Interest

Having been a subscriber to your magazine and its predecessors for a good many years, I feel that a few comments . . . are in order.

It is hoped that you follow through on the reader interest questionnaire. A number of readers, myself included, are not the least bit interested in b-w or, for that matter, color TV servicing. The reasons are . . .

A. A 21" b-w TV can be bought in the discount store for \$149. After about 3 years of normal home use what would be the first repair? In all probability, a major overhaul of the horizontal system, followed shortly by a picture tube. Common sense tells me that to spend such an amount as these jobs would come to would be economically unfeasible on a set 3 years old and that no customer would pay it . . .

B. A 21" color set can be had at the same place for about \$299 or less. The costs involved in keeping a color set working and maintaining the required test equipment makes working on these sets even more uneconomical.

C. Any technician can obtain employment as an electronic technician, specifications writer and similar skilled trade in any electronic (and many non-electronic) laboratories and factories for between \$3.80. and \$6.01 an hour with paid holidays, 2 to 4 weeks vacation a year, hospitalization and medical benefits, sick pay and regular hours. No TV/radio service shop can compete with these rates and charge what the customer would be willing to pay.

D. Many of your readers are interested in maintaining the better quality hi-fi/stereo systems, marine and mobile radio-telephone & radar systems, electronic organs; small computer equipment, and copiers, etc., which are being advertised and sold. To whom will these owners bring them? Is it up to your magazine to live up to the name to which it changed and provide us with this type of data?

Harry Hatfield  
14-A Rye Colony  
Rye, New York 10580 ▲

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**RCA**



Fig. 1 Using a portable high-voltage meter to check the high voltage at the anode of a color picture tube. Make sure ground lead of meter is firmly attached to the high-voltage cage.

# Color TV Setup— The Professional Way, Part 1

by Wayne Lemons

*First of a two-part series outlining step-by-step setup procedures—what adjustments are required and when.*

Color set-up procedures are streamlined and refined every year by technicians installing new sets and servicing older units, and by factory technicians whose pay often depends on just how fast and how proficient they can perform a setup job.

Generally any method that produces a suitable picture (with one or two important exceptions) in the shortest possible time is a satisfactory setup procedure.

In this first article we will discuss the preliminary steps of color TV setup using the most expedient but accurate techniques that have evolved to date.

Most color sets now coming off the line are checked at least two or three times to make sure that all the major adjustments are correct. This means that the typical new set needs only minor touchup. For example, you usually will not need to change the horizontal size (if such a control is used), vertical height or linearity, pincushioning, focus, color-killer, AGC, etc., and, though it is wise to check high voltage, you often will find it already within tolerance (about 2%).

Also, you will not need to change dynamic convergence adjustments, (you may possibly have to change static convergence slightly) unless

convergence is poor in the mid portions of the screen. As a rule, both factory and home service technicians do not worry about poor convergence that is confined to within one to two inches from the edge of the top, bottom and sides of the screen.

You should always check the gray-scale tracking and touch it up if necessary. Any color tint on a black-and-white picture indicates poor tracking.

Always degauss the CRT and chassis with a portable degaussing coil. Although most automatic degaussers are able to eliminate most of the effects of magnetism, a professional should not install a set without making at least 5 or 6 passes across the CRT face with a portable degaussing coil.

Always make sure that the picture is "straight" (no tilt.) If you must straighten the picture, carefully loosen the yoke wing nuts and rotate the yoke to straighten the picture, but be sure that the yoke does not move forward or back, or you'll have to reset the purity.

## Major Setup Adjustments

Major setups usually are needed only if the TV has been "adjusted" by a novice technician or novice

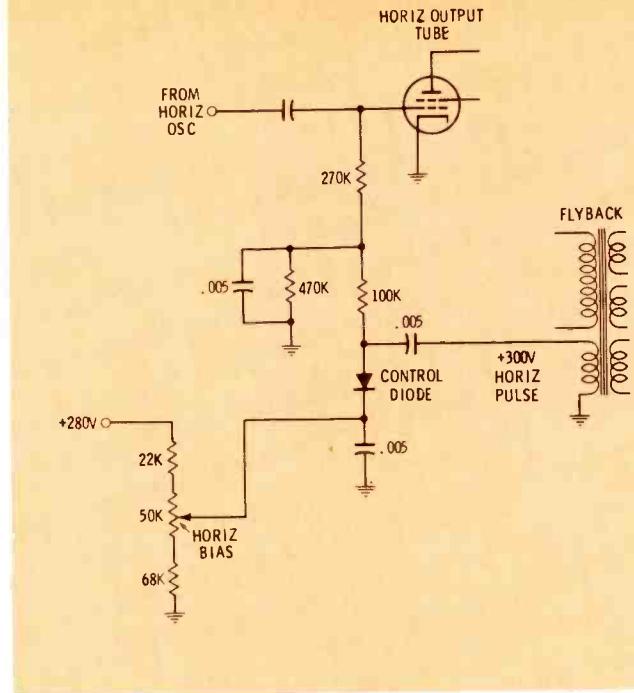
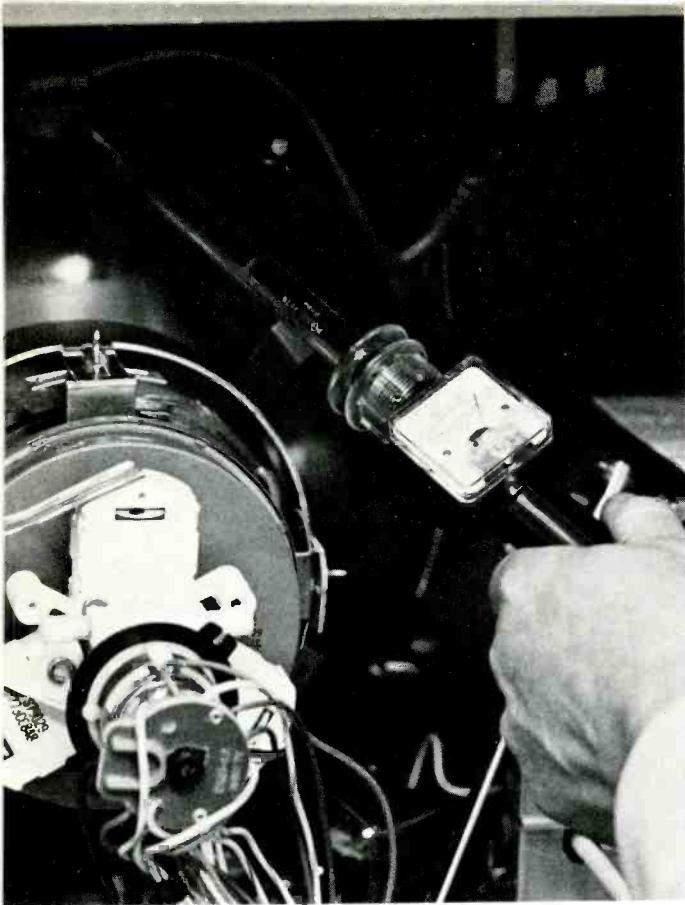
owner, or one that has had shop surgery to correct faults in the sweep or convergence circuits. It is here that the technician should follow a routine—one that works best for him on a particular make or model, or one suggested by the television manufacturer.

The following setup procedure will produce a satisfactory picture on almost any color set. The procedure should be performed in the order given here.

### Degaussing

As already mentioned, don't depend on automatic degaussers when you are performing an initial color setup (although they may do the job); however, do make sure that the automatic degausser is working. Look at the schematic and determine what specific procedure you should use to check the degaussing action. Since the degausser normally works only when the set is cold, and because the effects of its normal operation are not immediately apparent, there is no definite indication that it is doing its job. In most cases the degaussing coils are in series with the power supply and are shunted by a thermistor that has high resistance when cold.

To check the degausser, use a jumper to shunt the thermistor while



**Fig. 2** A "diode" high-voltage regulator circuit. The control diode rectifies a pulse from the flyback and controls the horizontal output tube bias to increase or decrease the horizontal drive. The control labelled "HORIZ BIAS" might also be called a "HIGH-VOLTAGE ADJUSTMENT" or "HORIZ SIZE" (see text).

the set is playing. After allowing about 5 minutes for the thermistor to cool, remove the jumper and you should see for a few seconds the characteristic colored whorls produced on the screen by the degaussing action. Always use a portable degaussing coil to insure complete elimination of any magnetization. Most professionals use the portable degaussing coil as good servicing practice to reduce the probability of having to make readjustments.

#### High Voltage

At one time, measuring regulator current was part of a major color setup procedure. Although it is still specified for specific sets, the different kinds of regulators now used and the portable high-voltage tester have eliminated the need for regulator current adjustments in most chassis. If a malfunctioning set uses a shunt regulator (6BK4, 6LE4, etc.) and the defect requires replacement of a component in the regulator circuit, then by all means measure the regulator current; but for routine setup of a color receiver, it isn't necessary.

If the voltage can be adjusted to the level specified by the service literature, the regulator circuit is probably operating satisfactorily, since the high-voltage adjustment is

electrically in the regulator circuit. As an additional check, rotate the brightness control and make sure the high voltage stays within about 5% of the normal level.

Be sure to set the high voltage according to the instructions contained in the service literature for each set. Too much high voltage can cause set damage as well as increase the danger of X-radiation.

The Table on page 16 shows how the line voltage affects the high-voltage setting. If the line voltage cannot be varied, measure the line voltage and adjust the high voltage of the set to the value indicated in the table. (This table is valid only if the normal high voltage of a receiver is 25 kv with 120V AC input.) Most large-screen color receivers should be set for 25 kv with 120V AC line voltage; however, one major manufacturer recommends 27 kv with 122V AC line input on their "works in a drawer" design. Smaller color tubes usually use less high voltage. A 14-inch tube for example, may be set at around 21 to 22 kv. Always check the service literature if you're not sure what the normal high voltage should be, or if it is not listed on the chassis.

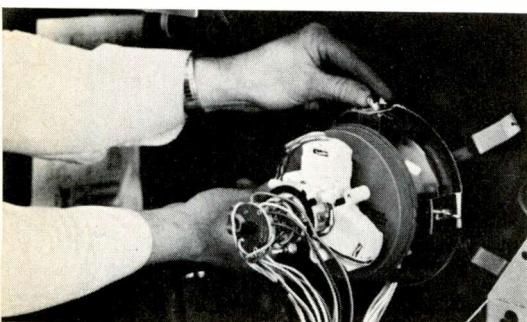
A handy way to check high voltage, and one that has caught on

with many technicians, is the portable, one-piece high-voltage meter shown in Fig. 1. This unit can be carried easily in a tube caddy and has adequate accuracy; however, occasionally check it against a known standard, especially if it has been accidentally bumped hard.

Some technicians use alternate methods for checking high voltage. One way is to reduce the line voltage to about 100 volts and then adjust the high voltage so that the raster just fills the screen. This works best for the technician who is familiar with the make and model of the set he is servicing, knows from experience that he has no sweep troubles and has learned to judge the performance of the high-voltage system by certain telltale indications in the raster. As another example, one manufacturer recommends, as an alternate method, that the high voltage be adjusted to the level that produces the straightest lines (crosshatch pattern) at the sides of the raster. This method is satisfactory only if the horizontal pincushion circuit is functioning satisfactorily.

By far the safest method to check high voltage is with a meter, especially if the set is not a new one.

Lately, the high-voltage adjust control has been removed from

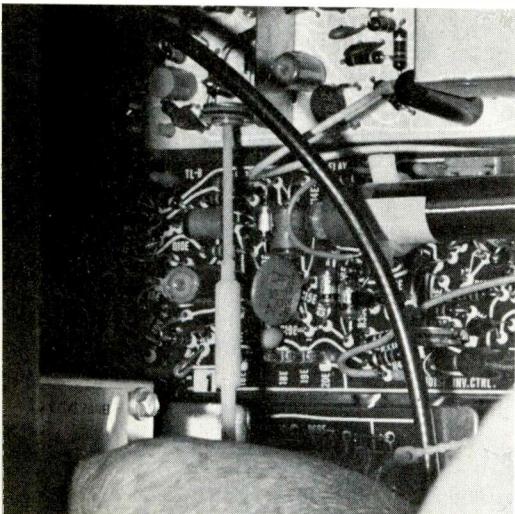


**Fig. 3** The technician in this photo is loosening two of the three wing screws that secure the yoke saddle in a Zenith TV set. Loosening the screws permits the yoke to be rotated for correction of tilt, or moved forward or backward for purity adjustment.

**TABLE 1**

If line voltage is:	High voltage should be about (in kilovolts)
100	20.9
105	22.2
110	23.2
115	24.4
120	25.0
125	25.6
130	26.5
135	27.1

Measure high voltage with brightness at minimum setting.



**Fig. 4** A hex-type tuning tool is used to adjust the AGC delay control in a Motorola "works-in-a-drawer" color TV chassis. The control is adjusted to produce a minimum amount of snow in a relatively weak picture.

some designs by some set makers. However, don't neglect to check the high voltage with a meter to make sure that it is within tolerance and to make sure that the regulator circuit is actually working, even though there is no manual high-voltage adjustment.

When a meter is used, the high voltage is adjusted with the raster extinguished. One major manufacturer that uses a "power" regulator advises that the horizontal hold should be checked to make sure it is locked in before turning the brightness down to check the high voltage, since in this circuit design the high voltage will change if the horizontal is not locked in.

#### Horizontal Size

This control is not used on many late model sets, although at least one manufacturer labels the high-voltage adjustment as "horizontal size." This is because the amount of high voltage determines the amount of horizontal sweep; this is even more evident with diode and VDR regulator circuits, in which the bias of the horizontal output tube is changed by the high-voltage adjustment. The control labelled "HORIZ BIAS" in Fig. 2 could also be labelled "HORIZ SIZE" or "HIGH VOLTAGE."

#### Tilt

Be sure the picture is not tilted; if it is, rotate the deflection yoke after loosening the wing screws. As mentioned previously, be careful not to move the yoke backward or forward on the neck of the CRT while making this adjustment.

Some new sets have three wing nuts holding the yoke instead of two. Make sure all three are loosened before attempting to rotate the yoke as shown in Fig. 3.

#### AGC

Color receivers have one or two AGC controls, depending on the design. Transistorized sets usually have two, while tube sets usually have only one.

The "regular" AGC control should be adjusted with the receiver set to a strong signal, and should be rotated until the picture overloads or becomes unstable, then adjusted

back until the picture clears up. Check all channels to make sure that each produces a satisfactory picture and there is no sync instability or sound buzz.

Transistor sets usually have an AGC delay control. Fig. 4 shows the location of the AGC delay control in a Motorola chassis. These controls are factory set; but when field adjustment is needed, tune in a weak signal and adjust the control for the best signal to noise ratio (least snow in the picture).

#### Vertical Size and Linearity

The vertical-size and linearity controls are usually adjusted for about  $\frac{3}{4}$  inch overscan at the top and bottom on large-screen color receivers. One precaution: Be sure to set the height and linearity BEFORE making convergence adjustments and do NOT touch up height and linearity on a new set if it appears to be okay; if you do, you may have to reset dynamic convergence and perhaps purity. The old adage "leave well enough alone" applies here—unless you plan to do a convergence setup anyway.

#### Pincushioning

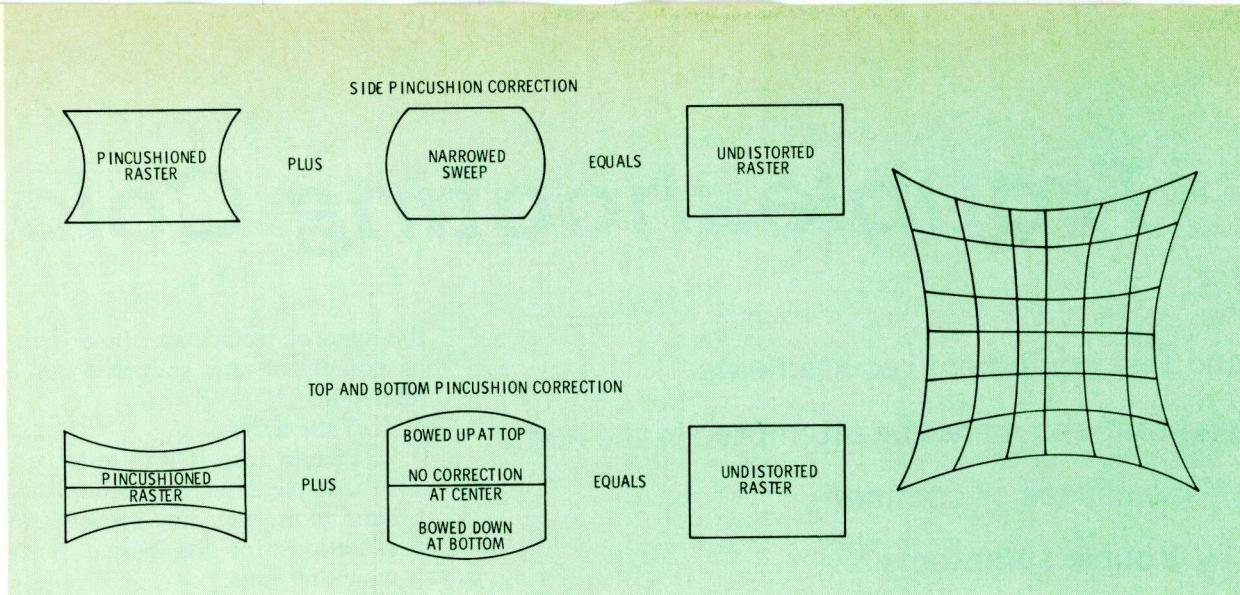
Pincushioning is the result of nonlinear sweep at the edge of large picture tubes, and is shown in exaggerated form in Fig. 5. To accurately check the operation of the pincushion correction circuits and to properly adjust them, a cross-hatch pattern should be displayed on the screen of the color receiver.

Be sure that the high voltage has been adjusted properly before checking pincushioning. Even though the operation of the pincushion correction circuits appears normal, it is a good idea to check the action of the adjustments. Some chassis, for example, may blow fuses intermittently if the pincush-

#### Got A Troubleshooting Tip?

If you've recently run across an unusual trouble symptom, send a thorough description of it and the solution to:

Troubleshooting Tip,  
Electronic Servicing  
1014 Wyandotte St.  
Kansas City, Mo. 64105



**Fig. 5** An exaggeration of the pincushion effect that must be corrected by adjusting the pincushion correction controls.

ioning circuit is not functioning correctly.

#### Focusing

Focus adjustments should be made only after the high voltage has been set correctly, because adjusting the high voltage usually changes the focus. The focus should be adjusted by viewing a picture with normal contrast and brightness. Adjust the focus for the best fine detail in the picture rather than for perfect raster lines. (The two conditions do not always coincide.) If you do prefer to use a crosshatch pattern instead of a picture, use the raster lines as an indication of focus rather than the crosshatch bars as illustrated in Fig. 6.

Be sure that proper focusing is obtained with the focus control set near the mid part of its range. If the focus is obtained only at the end of the control's range, it will probably prompt a callback in the very near future.

Some small screen color sets do not use a continuous-focus control but, instead, have two or three taps to which the focus anode is attached for best focus. If the high voltage is set correctly, the focus tap will not normally need changing unless the picture tube is changed.

#### Color-Killer Adjustment

New chassis are being designed with fewer service adjustments. The color-killer control is one adjustment that gradually is being phased out. The "crystal ringing" circuit used in some newer chassis designs to recapture the burst phase pro-

duces little, if any, color confetti (or noise) during the black-and-white reception. Such designs either do not employ a color-killer, or if it is used, the adjustment is very broad and does not require a critical setting. For proper adjustment of the color killer used in "crystal ringing" designs, use the following procedure:

1. Rotate the color-killer control to its off position (color-killer circuit biased off);
2. Advance the color killer to produce a normal color picture;
3. Rotate the fine-tuning control until the picture begins to smear and color is lost;
4. Adjust the color-killer control to the point where color reappears;
5. Check all active channels for proper color.

To properly adjust the color killer operation of older color chassis and newer chassis still using the crystal oscillator with a phase detector, use the following procedure:

1. Tune in a weak black-and-

white picture (or an inactive channel);

2. Adjust the color-killer control to the point where color confetti just disappears;
3. Check each active channel for proper color reproduction and color-free black-and-white reception.

#### Brightness Range

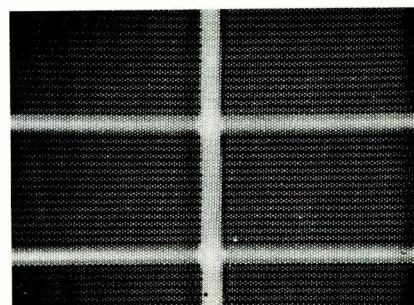
Most new color chassis employ a "brightness range" control to prevent the customer brightness control from causing blooming.

To adjust the "brightness range":

1. Adjust the customer controls for maximum brightness and contrast;
2. Advance the "brightness range" control until the picture just starts to bloom or goes out of focus, or in some chassis until the raster begins to pull in.

#### Next Month

Gray-scale tracking, purity, convergence, peaking, tint and hue adjustments will be covered in Part 2 of this series. ▲



**Fig. 6** An example of a well-focused crosshatch pattern. Note the sharpness of the scanning lines. When using a crosshatch pattern as an indication of proper focus, concentrate on the scanning lines. When using a picture, adjust the focus control for maximum fine detail in the picture.

# Troubleshooting Color

- Tool and test equipment requirements
- Servicing that should not be attempted in the home
- Tips on the causes of common color TV trouble symptoms

The repairs and adjustments made during home service calls are a very important part of the color TV servicing business. Proof of this statement is indicated by reports from many service organizations that out of approximately 8 home calls made, only one chassis is brought in for shop servicing. Although there are many possible variations tailored to meet specific local conditions, we will attempt to give some tried-and-proven tips about service data, test equipment, parts and diagnostic techniques that are needed for efficient and profitable color service calls.

## What Tools And Test Equipment Are Needed?

Every shop seems to have a different answer to this question, but let's discuss it by using the extremes of minimum and maximum.

First, consider a technician who is not yet very experienced, and whose shop manager orders him to make no parts replacements (other than tubes) in the home. He may be tempted to use only a tube tester, hand tools and replacement tubes; but this lack of equipment will severely limit his technical development, and will probably cause many customers to doubt his ability. For

this type of technician, these items of equipment are suggested as a minimum:

1. Tube tester.
2. Picture tube (CRT) tester.
3. Complete set of good-quality hand tools, including sockets and extensions for the buried tuner mounting nuts.
4. An adequate stock of replacement tubes.
5. Sams Photofact folders or other service literature for the models to be repaired.
6. Volt-ohm-milliammeter (VOM).
7. Color bar/crosshatch generator with gun-killing switches.
8. Degaussing coil.
9. Two mirrors, one large, one small.

Few of us would question the first four items. Photofact, or other service data, is necessary for color-killer adjustments, procedures and other vital information, even if circuit repairs are not attempted. A VOM can be used to test fuses or

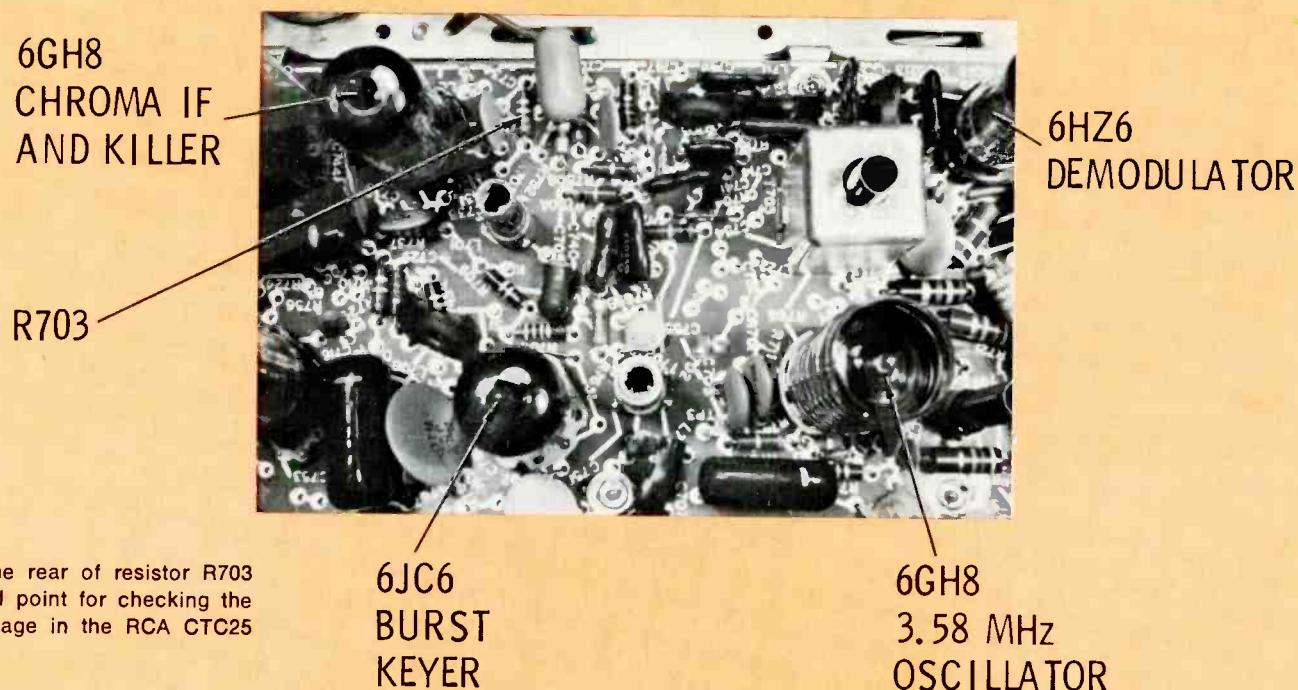


Fig. 1 The rear of resistor R703 is a good point for checking the killer voltage in the RCA CTC25 chassis.

# in the home

by Carl Babcock

circuit breakers, determine if a resistor which has been overheated by a shorted tube is still within tolerance, measure line voltage and many other simple but essential jobs.

After other repairs are finished, many receivers will need a touch-up of convergence and purity. It is a temptation for us to do this using the broadcast picture, but a poor job is likely to result, or such adjustments may take longer using this method than if a generator were used.

A crosshatch pattern is useful when you adjust height and linearity, or diagnose the source of width or horizontal linearity problems. If a customer should complain of a blurred picture or ghosts, the crosshatch pattern offers visual proof of sharpness and freedom from ghosts, thus isolating the trouble to the antenna or a location problem.

The mirrors permit rapid center convergence and purity adjustments.

The color-bar pattern is ideal for

checking color locking and tint control operation, but it can also be used to make an accurate estimate of the bandwidth, or alignment, of the entire receiver. Such a helpful method will be presented in a later issue.

Most modern color receivers have automatic degaussing of one type or another, but many older sets without this feature need degaussing as part of the purity adjustments. A defective automatic degaussing circuit can make the purity worse instead of better each time it operates. Degaussing with an external coil is an important step in the diagnosis of such a condition.

One practical solution to the problem of carrying all this assorted equipment into a home is to rip out most of the wooden dividers in a medium-sized tube caddy and use it as a combination tool kit and equipment case. The height should permit the degaussing coil and large mirror to stand upright, perhaps with cardboard or foam plastic

around them for protection. There should be plenty of room left for tools, meter, tuner lube and other necessities. The caddy and generator are all that are needed for set-up adjustments and many types of repair.

With only the minimum equipment listed previously a technician should be able to:

1. Test and replace any defective tubes.
2. Adjust purity and convergence, including width, height and linearity.
3. Check color locking, tint range and color-killer action, and make minor adjustments, if needed.
4. Determine if certain picture flaws are internal or external to the receiver by observing the crosshatch or bar pattern as a substitute for the station.
5. Adjust horizontal locking and stabilization.

A more knowledgeable and experienced technician should be able to go even farther in diagnosis and

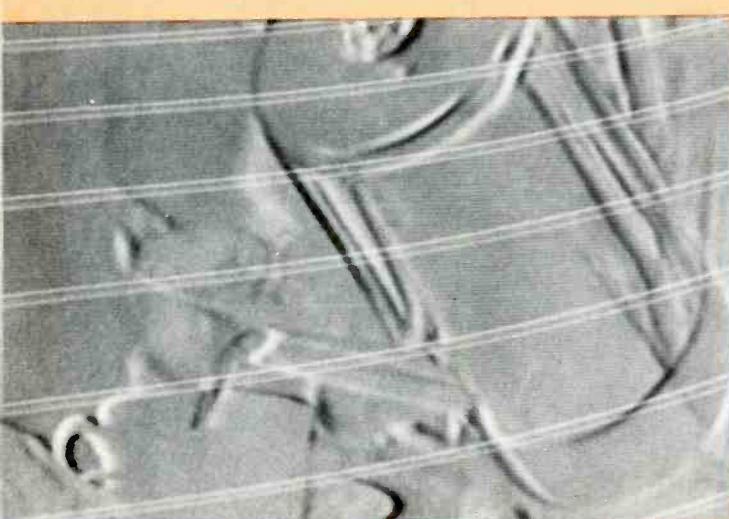


Fig. 2 This overpeaked picture was caused by an intermittent contact in the service-normal switch. The retrace lines are white.

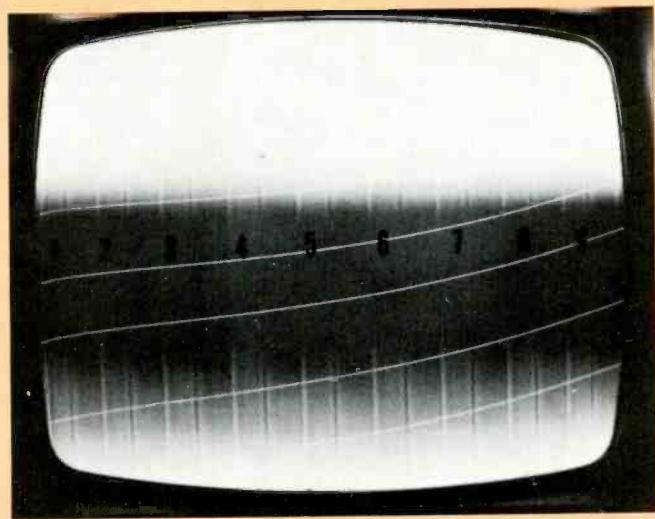
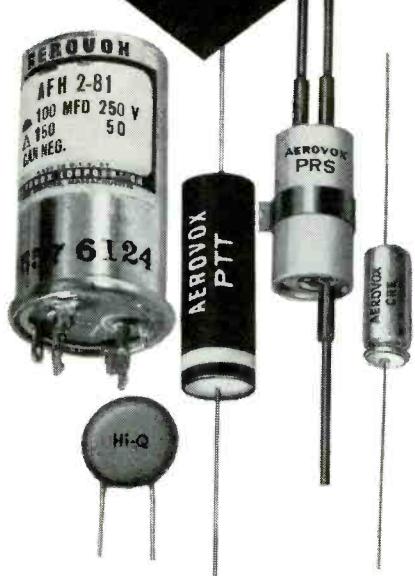


Fig. 3 A very strong hum bar may look like this. Other symptoms must be analyzed to locate the origin of the hum.

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repairs with the addition of the following items to the minimum equipment previously mentioned:

1. VTVM with a high-voltage probe.
2. Set of adapter sockets for measuring regulator and horizontal-output tube currents.
3. Assorted clip leads of various lengths and clip sizes.
4. Set of extension cables for operation with the chassis removed.
5. Magnifying (or reading) glass.
6. Soldering gun for large connections, and a small iron (not over 40 watts) for board repairs.
7. Reflector light with rubber-covered clamp, or a non-metallic flashlight.
8. Assorted chemicals such as oil, grease, chlorothene or alcohol and silicone grease. The last two items permit easy cleaning of tuner contacts.
9. A general stock of capacitors and resistors, plus any sizes needed for repetitive problems.
10. Assorted fuses and power-supply silicon diodes.

With the equipment included on both lists, a good technician should be able to accomplish the following additional procedures:

1. Adjust horizontal-efficiency coils.
2. Accurately measure the high-voltage and shunt-regulator current (if used) and readjust, if needed.
3. Find and replace most shorted capacitors and burned resistors.
4. Locate any bad solder joints or board cracks, and repair them.
5. Set the AGC correctly by either the DC or AC method recommended for that model.
6. Check for and correct most causes of wrong hues. (See page 52 in November, 1968 issue of PF Reporter for more details.)
7. Correctly perform all the color-locking and tint-adjustment steps, including those requiring a VTVM.
8. Clean corroded switch contacts in the tuner, or dirty tube socket pins.

### How Much Work Should Be Done In The Home?

One general answer to this question is: Only those repairs and adjustments for which the technician

has the equipment, tools, replacement parts and the knowledge to complete rapidly and accurately should be done in the home. Some shops try to clarify this idea by including a time limit. For example, if the set is not accurately diagnosed or repaired in 30 minutes (or whatever their rule says), it should be brought to the shop.

Many other factors influence the decision: Is the shop loaded to capacity, but the home calls light that day? If so, more time is justified in attempting to finish the repair in the home.

If the receiver is nearly new, it is advisable to make all repairs possible in the home, since shop work makes the problem sound more serious to the customer.

Shops or technicians who specialize in just one brand would be expected to complete more serious or complicated repairs in the home unless the technician doubts his ability to do a good job of convergence with someone watching, or unless there is a psychological problem with the customer.

Here are some of the repairs that should be brought to the shop without wasting much time:

1. Replacement of a major part, such as a power or high-voltage transformer or a high-voltage rectifier socket.
2. IF or chroma-IF sweep alignment. (Or a coil replacement, which would require alignment.)
3. Any case of tunable ringing not cured by tubes. (Alignment may be needed, or repairs followed by alignment.)
4. When the tint adjustments cannot be forced enough to give good skin color. (May need IF or chroma sweep alignment.)
5. Any case of shorted capacitors or burned resistors having a value not stocked in the kit, and the cause of the failure is not definitely known.
6. Intermittent operation of obscure origin.

### Tips For Color TV Service Calls

Knowing what stage or circuit to suspect by analyzing all the symptoms is a time saver, and it helps even if you are interested only in fast tube replacements. Such a method is absolutely essential for diagnosing and repairing color sets in the home. Here are some general

tips to help you locate the malfunctioning stage:

#### No Color or Weak Color

1. **Tuner:** If the fine tuning will adjust to the sound bars then back enough to eliminate them, the tuner cannot be the cause of no-color. It is even unlikely to cause weak color, except perhaps on just a few channels.

2. **Picture IF's:** Color can certainly be weakened, but it is nearly impossible to lose all the color in the picture IF's. As a fast test to see if there is a dead stage or very weak IF gain, tune in a blank channel, and observe the snow. Normal, heavy snow without horizontal streaks means the IF's have good gain, and it is not likely that you can improve the color while the set is in the home. Streaks in the snow indicate a near-regenerative condition resulting from improper alignment or other defects. No snow probably means an IF trouble which may be brought back to normal at the same time.

3. **Chroma IF.** The chroma IF amplifier circuit is the number one suspect when dealing with no color or weak color. Most modern color sets have color-killer and automatic chroma gain control (ACC) voltages and a horizontal blanking spike applied to the chroma IF. Unless the alignment has been tampered with, DC voltage analysis and the use of selected test points quickly will locate the defective part.

Consider the blanking pulse. It is usually injected by the blanker tube through a common resistor to the chroma IF tube cathodes. Excessive current through either tube may overload the resistor, raise its value and overbias the chroma IF tube, resulting in low gain or no gain. As a fast test, ground the cathode to see if the chroma gain increases.

Full killer action or an excessive amount of ACC might stop all chroma signal, while partial killer action or a little too much ACC would cause weak color. There is an easy way of defeating the killer and ACC function of each color chassis. Usually it involves connecting two terminals together or grounding another point. As an example, Fig. 1

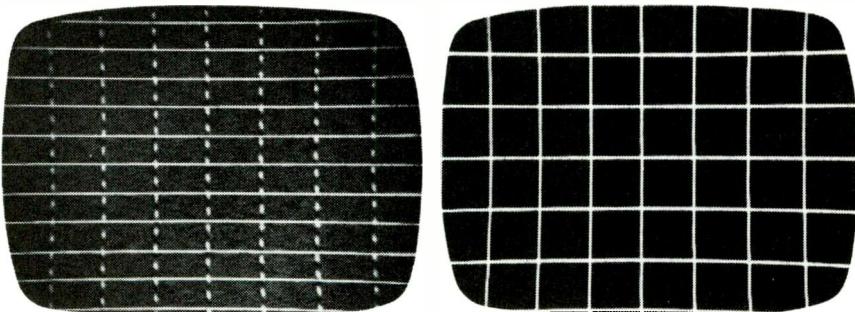
shows the point to measure for analysis, or to ground out the killer action in the RCA CTC25 chassis. In some later models the ACC voltage can be measured or grounded at this same point. The voltage at this point should be about zero during a colorcast. If it is —3 volts to —5 volts, the color will be weak; if it measures more than —8 volts, there will be no color.

If you grounded this resistor and obtained normal color with good locking, the defect is probably a killer problem or wrong

killer-control adjustment. But if grounding this point produces out-of-lock stripes, the basic problem is one of color locking, and not a defective color killer.

4. **Demodulator Signals.** Certain amplitudes of chroma sidebands from the chroma IF's and 3.58 MHz signal from the color oscillator are necessary for strong, saturated colors. If either or both are weak, the color on the picture tube will be weak. If either or both are missing, there will be **NO** color. A VTVM can measure these signals directly on the

## Make the wiggly test.



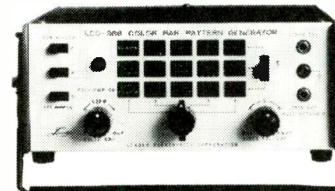
On the left, a pattern\* produced by an ordinary color bar generator. On the right, the equivalent pattern\* produced by Leader's LCG-388. Perfectly stable, the instant you turn the power on.

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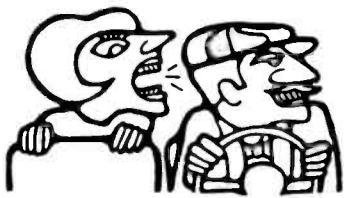


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AC peak-to-peak function if the circuit impedance is low enough. In other circuits, rectification of these signals gives a DC voltage proportional to the amplitude. Specific examples will be discussed in a later issue when the uses and locations of these valuable test points are given.

**5. Brightness And Screen Color Problems.** The source of these problems can be found by checking the color picture tube and the voltages applied to it. Briefly stated, loss of all focus voltage or high voltage is probably the most common chassis defect that causes loss of the raster. Low picture brightness can be caused by reduced screen (G2) voltages, low grid (G1) voltages or high cathode voltages.

Many circuit diagrams show the cathode voltages to be about +350, but this is the level measured off-channel. On-station, the cathode voltages must go down to between +280 and +310 to produce normal brightness. If the voltage measures around +370 and does not change when the brightness control is adjusted, the last video tube is not working. Some possibilities are a dead tube, no heater voltage, open cathode resistor (usually the contrast control), too much negative voltage on the grid, or no screen voltage.

These same cathode, grid and screen CRT voltages are usually the cause of a changed screen color, if it is not caused by the picture tube. Wrong grid voltages account for most of these cases—a voltage change of even 5 volts produces a noticeable change in color on the screen.

### Other Visual Symptoms

Picture tube heater-to-cathode shorts are more common because of the small gun structures in the rectangular tubes. The symptoms of such a short will vary depending on the setting of the video drive controls.

Sometimes there will be a complete loss of b-w video, although the color is not affected. If turning down one of the video drive controls brings back the picture, the short is to the cathode of that particular color gun.

Sometimes the contrast will dim and the picture will appear blurred. Customers often describe this effect as looking like a film over the screen. If there are red, blue, or green vertical-retrace lines on the screen, the color of the retrace indicates which gun is shorted.

Look at the picture in Fig. 2. Is this the result of a picture tube cathode-to-heater short? No! The vertical retrace lines are white, and the picture is not blurred. However, the picture is overpeaked so that the video is differentiated into spikes. This is the reason for the uniform gray (except for the white or black edges) around the picture elements. An open in the video path through the service-normal switch caused this symptom, which can be highly intermittent if it is caused by dirty or corroded switch contacts.

Fig. 3 is obviously hum viewed on a color bar pattern. But in what circuit does it originate? If the intensity can be changed by the contrast control, the source may be the tuner, picture IF's or video.

Turn to a blank channel. Is the hum bar still there? If so, it is a video defect. If not, the tuner or IF's are the source. In the rare event that turning the contrast control completely down eliminated the hum bar, it is quite possible the video-output tube has a cathode-to-heater short.

Does the hum change the intensity of the color bars in the hum pattern? If so, the hum is in the chroma IF stages, and turning the color control down should eliminate the bars as well as the color.

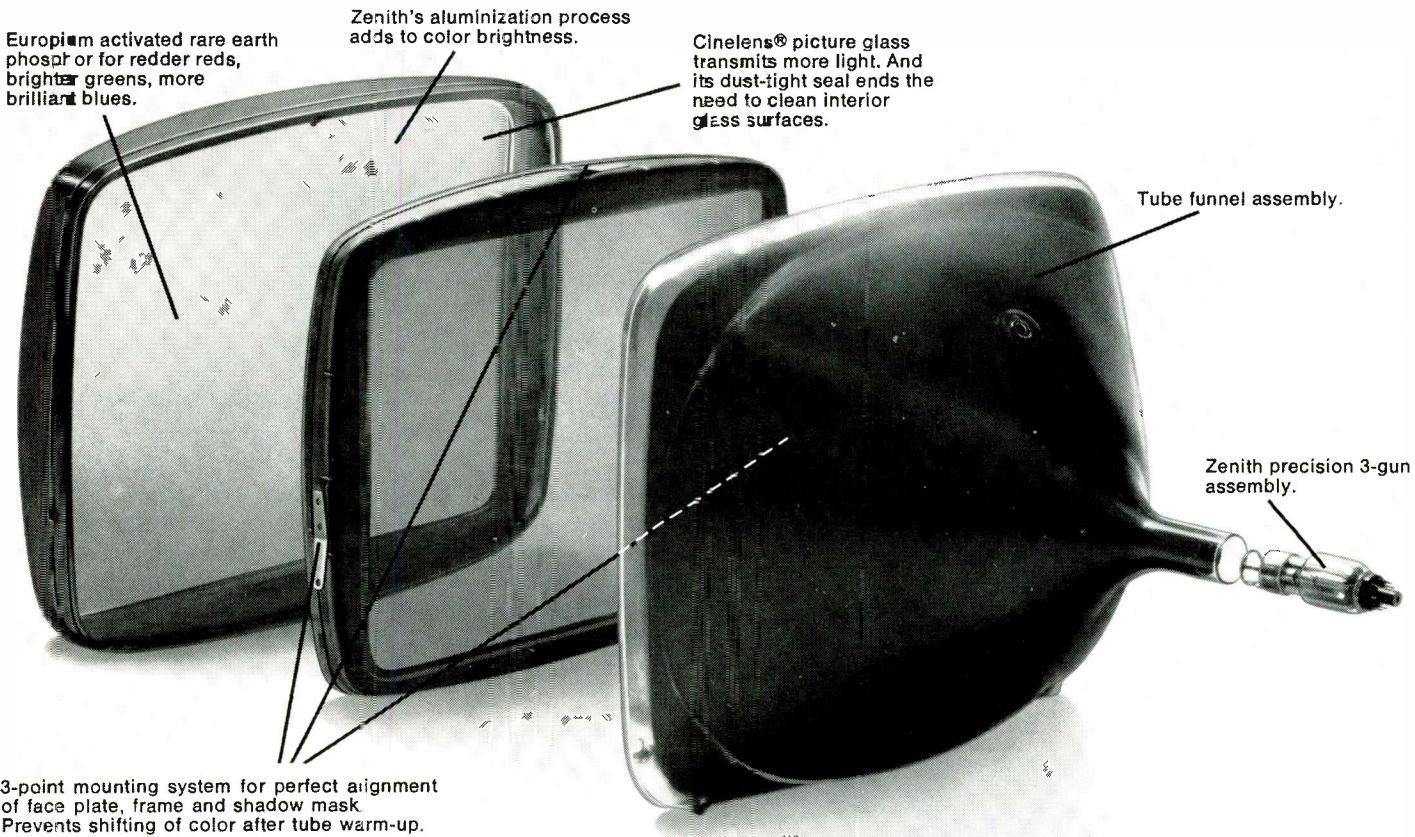
Is there a change in screen color between the dark and light areas of the hum bar when the color control is turned down? Then the source of the hum is in a high-level demodulator, or a —Y amplifier if "X" and "Z" demodulation is used. If this is the case, the vertical retrace lines should be of a color corresponding to which red, blue or green amplifier is the source of the hum.

One hum bar, as shown in Fig. 3, indicates that the frequency is 60 Hertz, and the most likely source is heater-to-cathode leakage in a tube.

Next month: Solving Troubles in High-Voltage Regulators

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# Troubleshooting Color Video Amplifiers

by Bruce Anderson

A practical discussion of how defects in the video amplifier affect picture quality and how they can be pinpointed quickly.

Possibly because they caused so little trouble in monochrome receivers, servicing the video amplifier has been a subject largely untouched by servicers.

Even in a color receiver, the video amplifier is often ignored as a source of trouble. This is unfortunate for several reasons: Since the video amplifier of a color receiver is much more elaborate than its monochrome counterpart, it is more susceptible to failure. Minor discrepancies in a color presentation are more noticeable than in a black-and-white picture, requiring nearly perfect operation of the video circuits.

This article will examine the operation of the video amplifier to determine how certain malfunctions affect the picture, and will describe convenient methods of troubleshooting these circuits.

## Video-Amplifier Theory

Before examining the actual techniques used in servicing, it is necessary to consider some of the basic requirements of the color-TV video amplifier. (For the purposes of this article, video amplifier is defined as the entire circuit between the video detector and the CRT, rather than one specific stage.)

Obviously, the first requirement is that it amplify the output from the video detector (about 2 volts, excluding sync pulses) to a level sufficient to drive the cathodes of the picture tube, roughly 140 volts. The voltage gain, therefore, must

be 70, and the power gain may be many times greater than this, since the output impedance of the amplifier is relatively low.

A more difficult requirement to meet in building a video amplifier is to maintain sufficient bandwidth.

Those familiar with hi-fi equipment will recall that a response which is flat from 50 Hz to 20 KHz is generally acceptable to all but the most particular, and that response from 30 Hz to about 200 KHz is typical for the better preamplifiers.

A video amplifier must have reasonably flat response from DC to 2.5 MHz, or more. If the chroma signal is taken from the output of one of the video-amplifier stages, the bandpass to that point must extend to about 4.2 MHz, although the response may be reduced several dB at these higher frequencies.

An examination of the circuits

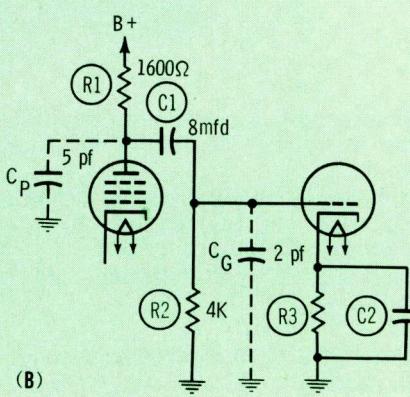
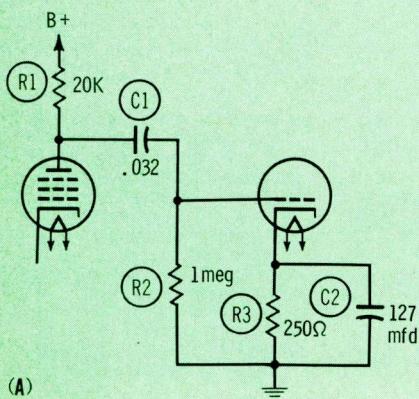


Fig. 1 Basic DC coupling circuit.

- Component values for audio frequencies.
- Component values for video frequencies.

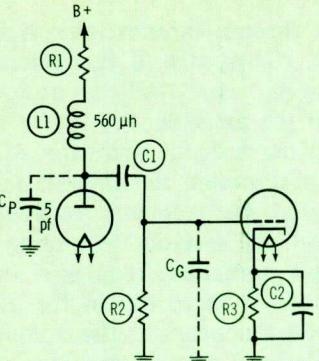


Fig. 2 An inductive plate load.

shown in Fig. 1 will help in understanding how the frequency response of an amplifier may be extended. For the sake of simplicity, only the output of the first stage and the input of the second is shown. It is assumed that the two stages are identical.

As long as the frequencies to be amplified are low (less than 100 KHz, for example), the selection of component values is relatively simple. In Fig. 1A, it was determined from a tube manual that R1 should have a value of 20K ohms, the cathode current would be 10 ma, the maximum value of R2 is 1 megohm, and that 2.5 volts of cathode bias is necessary. Calculating the value of R3 is the first step:

$$E = 2.5 \\ R = \frac{E}{I} = \frac{2.5}{.01} = 250 \text{ ohms}$$

Next, the value of C2 is determined. To insure that the stage does not degenerate at low frequencies, the impedance of C2 should be no more than 0.1 times the value of R3 at the lowest frequency to be amplified, 25 ohms at 50 Hz. The value of C2 is:

$$C_2 = \frac{1}{2\pi F X_C} = 127 \text{ mfd}$$

The value of C1 must be great enough so that its impedance will be no more than 0.1 times the value of R2 at the lowest frequency to be amplified, 50 Hz. If the impedance is greater than 100K ohms, a significant part of the signal at the plate of V1 will be dropped across C1 instead of being fed to the grid of the second stage, and the phase will be shifted significantly. Using

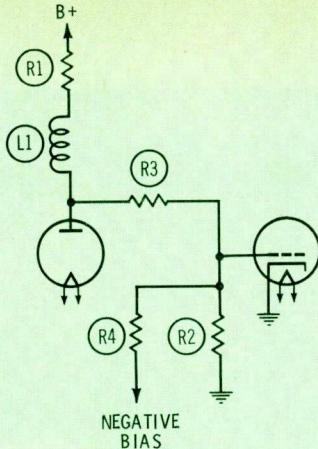


Fig. 3 A direct-coupled amplifier.

the same formula as before:

$$C_1 = \frac{1}{2\pi F X_C} = 0.032 \text{ mfd}$$

In Fig. 1B, the same circuit is shown, but two important items have been added, namely the capacitances which shunt the plate and grid circuits. These capacitances are the sums of the interelectrode capacitances of the tube elements and the stray capacitances of the sockets and wiring. The values can be minimized by careful parts layout, tube and socket selection, etc; but values of 5 pf for Cp and 2 pf for Cg are reasonable.

Considering the effects of Cp, whenever its impedance drops below 10 times the value of R1, it will begin to shunt the signal enough to cause phase shifting and loss of gain. The frequency at which this will occur can be determined by rearranging the formula used above:

$$F = \frac{1}{2\pi C X_C} = 159 \text{ KHz}$$

If the circuit is to have flat response up to 2 MHz, several component values must be changed. Since the value of Cp is fixed, the only possibility is to reduce the value of R1 until its resistance is equal to 0.1 times the impedance of Cp at 2 MHz:

$$X_C = \frac{1}{2\pi F C} = 15.9 \text{ K ohms}$$

and,

$$R_1 = 1600 \text{ ohms}$$

In the same manner, R2 must be reduced to one-tenth the impedance of Cg at 2 MHz; the new value of

R2 is 4000 ohms. Unfortunately, reducing the value of R2 makes it necessary to increase the value of C1, in order to maintain low-frequency response. Its new value is 8 mfd.

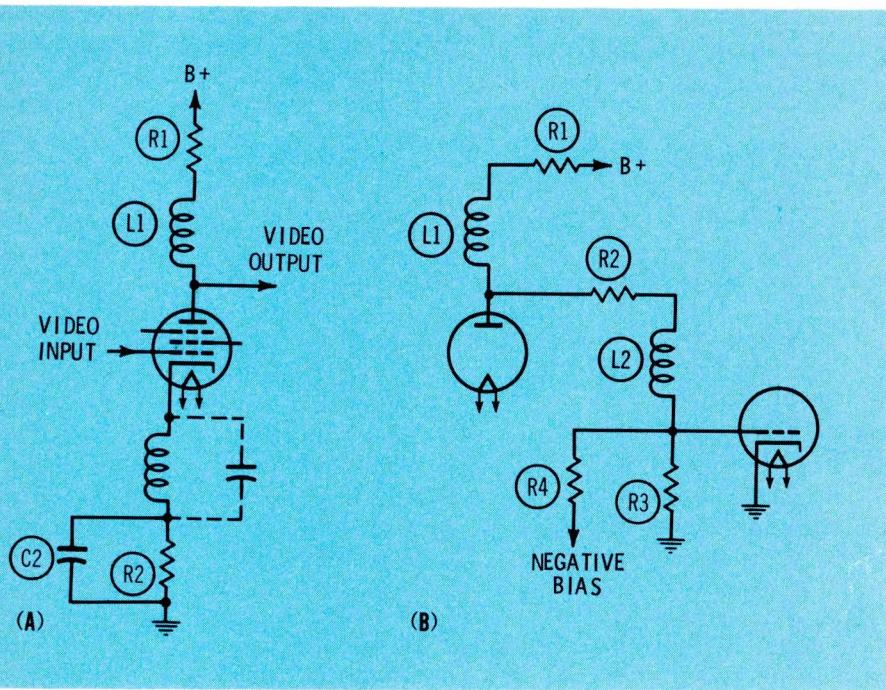
From the foregoing calculations (actually only approximations, although valid ones), it is apparent that component values become unwieldy when an attempt is made to extend the bandpass of an RC-coupled amplifier. Also, since gain is approximately proportional to the value of plate-load impedance, many additional stages are necessary to achieve as much gain in a video amplifier as in a comparable audio amplifier.

In order to reduce the number of stages necessary to produce the required signal level and also to reduce the value of coupling capacitors, video amplifiers used in television receivers usually include several inductances.

Fig. 2 shows how an inductive plate load extends the upper limit of the pass-band. If L1 has an inductance of 560 microhenrys, it will form a parallel resonant circuit with Cp at about 3 MHz. Therefore, the plate-load impedance is high at high frequencies and the gain is effectively increased. Since L1 has very little impedance at the low-frequencies, the gain is effectively increased. Since L1 has very little impedance at the low-frequency end of the passband, R1 is left in the circuit to keep the output reasonably flat.

Since the plate impedance (and hence the gain) increases as the frequency is increased, the size of R2 may be increased from its low value of 4000 ohms. As mentioned before, the effect of Cg is to reduce gain at high frequencies, and this tends to compensate for the rising gain of the preceding stage. It no longer is necessary to reduce R2 to 0.1 of the impedance of Cg at the high-frequency limit. Instead, R2 may be in the range of 25K to 50K ohms. (To determine its exact value is beyond the scope of this article.)

As the value of R2 is increased, the value of C1 may be decreased without affecting the low-frequency response; however, it is sometimes desirable to eliminate C1 altogether



**Fig. 4** Frequently used traps.

A. Cathode trap.

B. Interstage trap.

and use direct coupling between stages. By eliminating the coupling capacitor, the low-frequency limit is extended to zero Hz, or DC. This is shown in Fig. 3.

As the value of  $R_2$  is increased, the value of  $C_1$  may be decreased without affecting the low-frequency response; however, it is sometimes desirable to eliminate  $C_1$  altogether and use direct coupling between stages. By eliminating the coupling capacitor, the low frequency limit is extended to zero Hz, or DC. This is shown in Fig. 3.

The major disadvantage of direct coupling lies in the fact that the grid of the second stage no longer is isolated from  $B_+$ . Therefore, one of three things must be done to maintain proper bias: (1) Let the grid of the second stage be positive and apply positive bias to the cathode. A corresponding increase in  $B_+$  also is necessary. (2) Operate the first stage with the cathode and grid very negative, and return the plate-load resistor to ground. (3) Use a bias supply and voltage divider to fix the second-stage bias slightly negative. This latter method is used quite often; bias is obtained from the grid circuit of the horizontal-output tube.

Also, the need for a cathode-bias resistor and its bypass capacitor is obviated, an economic factor.

In a television video amplifier, flat frequency response is not always desirable. In fact, it is important that the 4.5-MHz audio and 3.58-MHz chroma signals do not appear at the CRT cathode.

To prevent these two signals from passing through the video amplifier, selective filters, or traps, are usually designed into the circuitry. These traps may be either series resonant or parallel resonant, and in many cases, they consist of only a coil which resonates with its own distributed capacitance. Because of this, it is quite difficult to determine the exact function of a coil shown on a schematic; however, some inkling of the function of a coil may be had by noting its position in the circuit. Fig. 4 shows how this may be done.

In Fig. 4A, the inductance in the cathode circuit most probably is a trap—it is unlikely that a non-resonant coil would serve any useful purpose in this location. If it is a trap, it should be parallel resonant at either 3.58 or 4.5 MHz. This being the case, it is of no concern unless the problem is exces-

sive chroma interference or sound bars. (Obviously, if the inductance is open, there will be no output from the amplifier.)

If the cathode inductor of Fig. 4A is resonant, the cathode impedance at the resonant frequency is very high, severely restricting gain at this particular frequency. In this manner, a sharp dip in the overall response appears at this frequency. This sort of trap is sometimes called a "notch filter."

In Fig. 4B,  $L_2$  is in series with the signal path, so it is reasonable to assume that it also traps out a specific frequency. To attenuate all frequencies except one (action of a pass filter) would be wasteful of gain. In this circuit, there would be practically no gain if  $L_2$  should open.

In Fig. 5, the two stages are direct-coupled by  $R_3$ , extending the low-frequency response to DC.  $L_2$  and  $C_1$  are series resonant near the upper-video-frequency limit. Unlike the circuit of Fig. 3, where all frequencies are attenuated to a degree by  $R_3$ , in Fig. 5 the higher frequencies are shunted around  $R_3$ . As a result, the circuit in Fig. 5 tends to extend the upper limit of frequency response.

If  $C_1$  in Fig. 5 shorts or becomes leaky, or if  $R_3$  changes value, the grid bias of the second stage will be changed, seriously reducing its gain and affecting brightness if the remaining stages also are direct-coupled.

On the other hand, a change in value of  $L_2$  or  $C_1$  will change the high-frequency response of the stage and could cause smearing.

#### Isolating Faults To The Video Amplifier

Faults in the video amplifier may be divided conveniently into three broad categories; loss of gain, incorrect brightness, and poor response.

The first group of faults causes a weak or "washed out" picture, with normal raster brightness.

The second category includes those faults wherein too much or too little brightness is the symptom.

The final category, poor response, is evidenced by trailing blacks or whites (streaking), smear,

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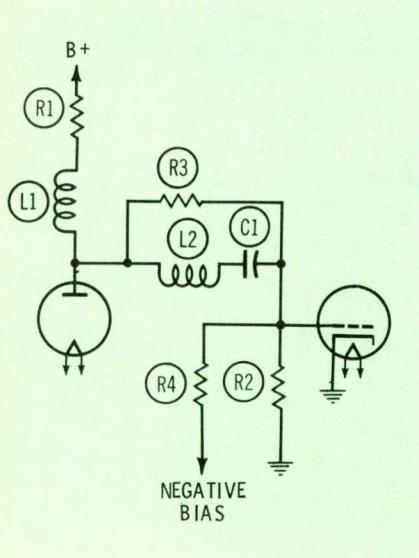
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**Fig. 5** Direct coupling with high-frequency enhancement.

ringing or edge effect (grainy picture).

To complicate matters, each of these symptoms may be the result of malfunctions which are not in the video-amplifier system. Insufficient contrast may be caused by insufficient gain in the tuner or IF sections of the receiver. Loss of raster or a dim raster may be caused by failure of the high-voltage system or the CRT itself; smear and ringing can be caused by impaired tuner or IF alignment.

Fortunately, it usually is not difficult to eliminate the other possible causes of the trouble, particularly those resulting in low contrast or

low brightness. If the peak-to-peak amplitude of composite video signal observed at the output of the video detector is normal from the particular receiver being serviced, low contrast symptoms are probably the result of video-amplifier failure.

Fig. 6 is a photograph of a normal composite video signal observed at the second detector of an RCA CTC40 chassis. (To obtain this waveform a wide-band scope was used, with the sweep frequency set to the "TV vertical" position and internal sync was selected.) Notice that the peak-to-peak amplitude is about 3 volts and that the video level is about three-fourths of the sync-tip level.

In other sets, the video from the second detector may be either positive or negative, but the amplitude may be different; a look at the Sams Photofact or the manufacturer's data will tell precisely what it should be. In nearly every case, the ratio of video level to sync-tip level will be the same as shown in Fig. 6.

If the problem is no raster or a dim one, the voltages applied to the CRT should be checked. Improper voltage to the aquadag, screen grids, focus grids, or control grids may be the cause. The problem is likely to be in the video amplifier only if the cathode voltage is abnormal. Incidentally, it is possible that low filament voltage can exist in some receivers, particularly those with "instant-on."

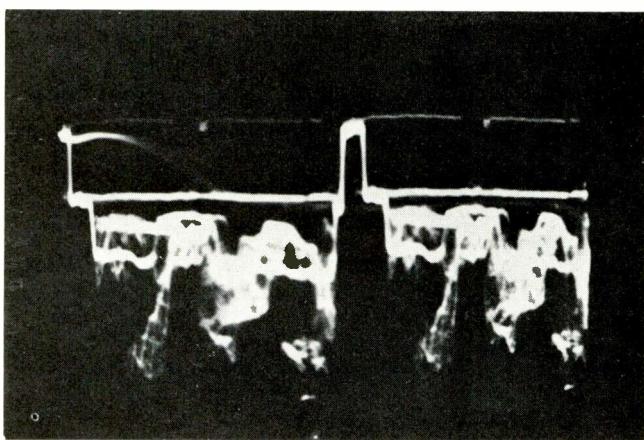
Problems which involve smear, ringing, etc., also may arise; either

in the video amplifiers or elsewhere. The first step in determining the origin of the trouble is to observe the output of the video detector. Observation of the horizontal sync pulse at this point will give a fairly accurate indication of the performance of the preceding stages. A good-quality, wide-band scope must be used. Connect the video signal to the vertical input, set the sweep rate to 15,750 Hz, and obtain sync either from the scope internal sync facility or from a pickup wire looped around the yoke cable and attached to the "external sync" input. (External sync usually gives a more stable sweep, although internal sync is adequate with most scopes.) By using the scope centering controls and increasing the horizontal gain, the sync pulse can be observed in detail.

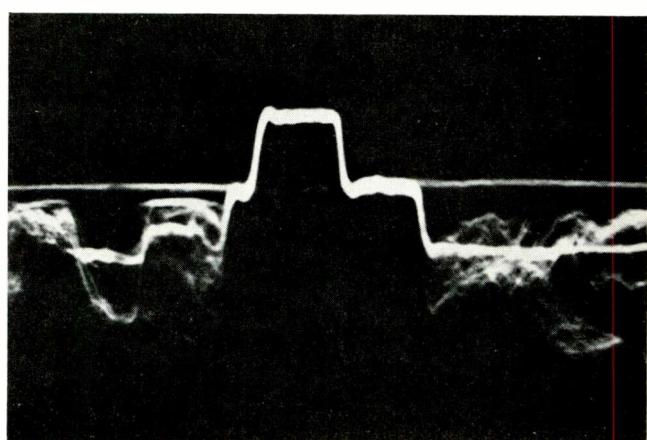
Fig. 7 is a photograph of a normal horizontal sync pulse. The leading edge rises sharply, the top is flat, and the trailing edge falls cleanly down to the back porch. If the leading or trailing edge of the pulse has excessive slope, if the top of the pulse is not flat, or if there is evidence of oscillation (ringing) at the shoulders of the pulse, there is probably some misalignment in the tuner or IF section.

#### Weak Or No Video

Problems involving loss of video (partial or complete) are usually fairly easy to solve. By simply signal tracing with a scope from the detector towards the CRT, the point



**Fig. 6** Typical video-detector output composite video on 2H time base.



**Fig. 7** Horizontal-sync pulse.

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at which video is lost or suffers a drop in amplitude can be quickly spotted.

Often it is possible to save a lot of time by checking a few key points. One likely source of trouble is the delay line.

It is normal for a delay line to have from 3 dB to 6 dB of attenuation; therefore, the output signal amplitude will be between 50% and 70% of the input. If it is much less than this, the line may be defective. Be careful to check the signals at the terminals of the line, not on the opposite end of a loading device, since the output at this point may be less.

A good example of this is found in the RCA CTC40 chassis. (See Fig. 8.) Although about 2 volts of video is present at the delay-line output, practically none is measurable at the emitter of Q1. This is normal because Q1 is connected in a common-base configuration, which has practically zero input impedance; nearly all of the signal voltage is dropped across R1.

A second likely cause of lost video is the large capacitor connected to the contrast control. Fig. 9 shows the circuit used in the General Electric FY chassis. As the resistance between C1 and the video-amplifier cathode is increased, there is more degeneration and less video. If C1 opens or decreases in capacitance, the gain of the video amplifier is seriously reduced. Since most receivers use a similar circuit, many smart technicians begin trouble-

shooting by jumpering a 50-mfd capacitor from the video-amplifier cathode to ground.

#### Incorrect Brightness

If a dark, dim, or excessively bright raster is caused by improper voltage on the cathode of the color CRT, voltages in the video-amplifier stages should be checked, beginning at the CRT cathodes and working back towards the video detector.

Since several (if not all) of the stages are direct-coupled, the actual source of trouble may be several stages in "front" of the CRT.

Suppose, for example, that there are three direct-coupled stages and that their overall gain is 50. If the cathode biasing resistor in the first stage should increase sufficiently to increase the cathode potential one volt, this increase would be amplified in the same manner as a video signal, resulting in the CRT cathodes being 50 volts more positive than normal. This, of course, will seriously limit the brightness. Conversely, if the cathode bias should increase the same amount, the raster would be extremely bright, or it would bloom on highlights.

#### Poor Video Response

The shape of the horizontal-sync pulse at the video detector can be examined to determine if alignment of the tuner and IF strip is correct.

Unfortunately, most color receivers blank the video amplifier with a pulse from the deflection system,

so that sync pulses are no longer visible at the cathodes of the CRT. Since this is the case, some other suitable pulse must be injected into the video amplifier for test purposes. The output from a square-wave generator is ideal for this purpose.

#### Connecting the Generator

There are two basic methods of feeding the square-wave signal into the receiver. One is to feed it directly to the grid (or base) of the first video amplifier, in place of the second-detector output. If this method is used, the tuner or IF amplifier must be disabled to prevent receiver noise from interfering with the test signal. This may be done either by removing an IF-amplifier tube, clamping the AGC line with cut-off voltage, or disconnecting the tuner output from the IF strip. Also, the square-wave output from the generator probably is at ground level. (Positive half-cycles are positive with respect to ground and negative half-cycles are negative with respect to ground). The normal input to the video amplifier is either all-positive or all-negative with respect to ground. This may lead to distortion of the input signal.

If a marker generator having provisions for external modulations is available, a better method of injecting the square wave is possible: Use the square-wave generator to modulate the marker generator and connect the marker generator to the

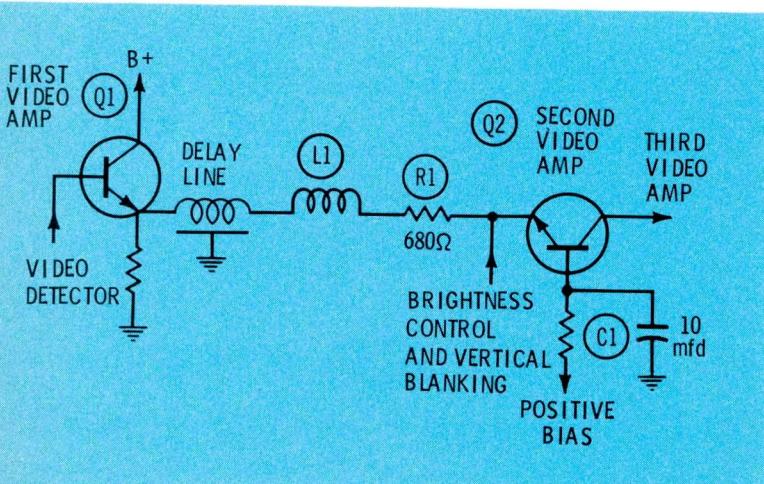


Fig. 8 Delay-line circuit of RCA CTC40 chassis.

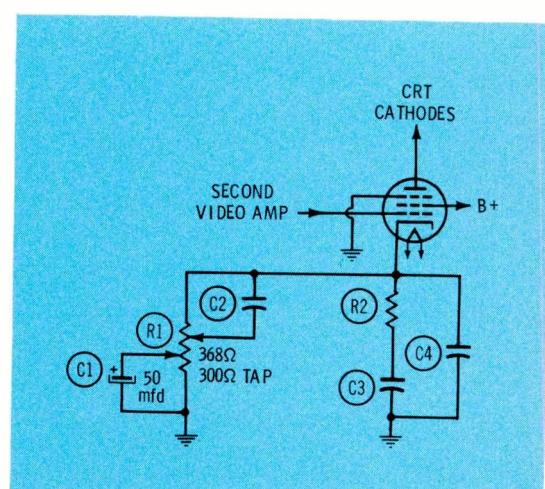
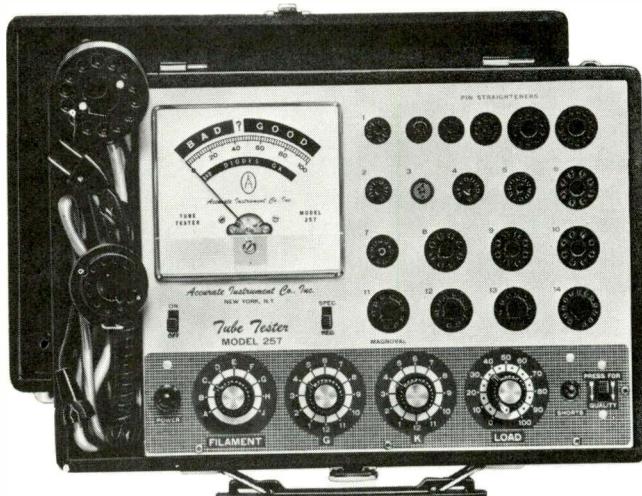


Fig. 9 Typical contrast-control circuit.

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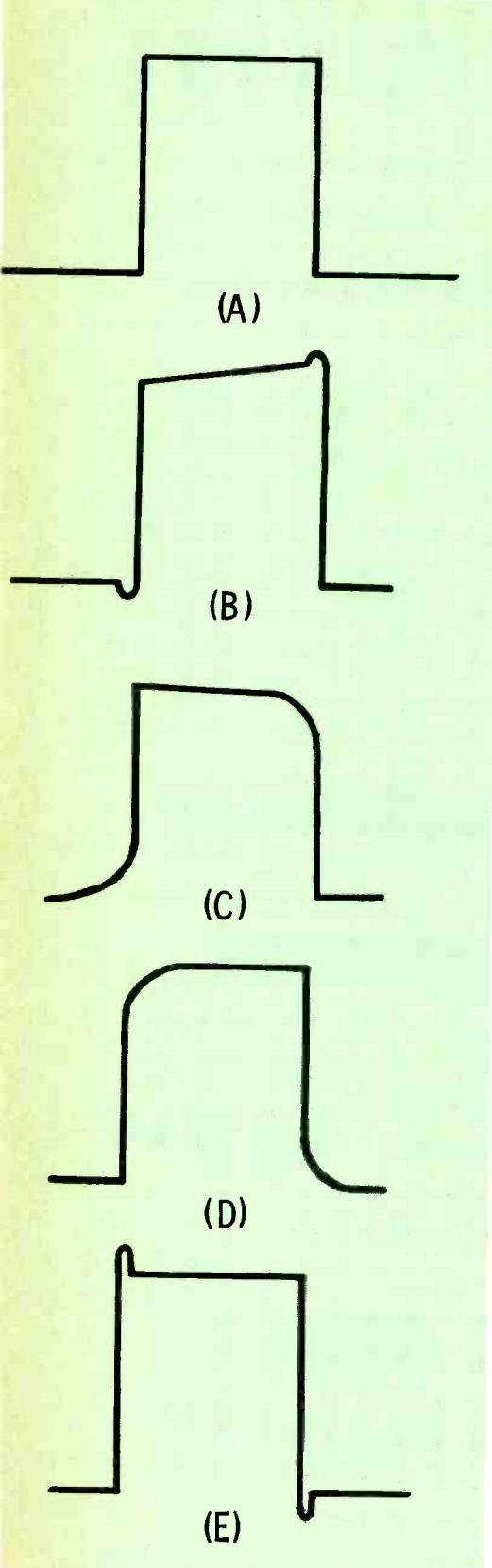
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**Fig. 10** Effects of video response on a square wave.

- A. Normal square wave.
- B. Excessive low-frequency response.
- C. Insufficient low-frequency response.
- D. Insufficient high-frequency response.
- E. Excessive high-frequency response.

antenna input of the receiver. This method is easier and also has the advantage of not disturbing the internal circuitry of the receiver. It is necessary to insure that the levels from the marker generator and the square-wave generator are not so great that the receiver is overdriven, but this is not difficult.

Regardless of the system used, the signal level at the output of the video detector should be the same as that of the normal video signal. If the video output of the detector is 2 volts, for example, then the square-wave amplitude at this same point should be set to 2 volts. A square-wave frequency lower than 15,750 Hz is seldom necessary to check the video response, and the actual frequency used should be either 15,750 Hz or some multiple of this frequency. This will allow the horizontal oscillator to sync to the waveform at its normal frequency, allowing the AGC and deflection circuits to operate properly.

In this discussion, it is assumed that the square-wave generator is used in conjunction with a marker generator, since this method is best. (Incidentally, the vertical-bar output of some pattern generators will provide sufficiently stable video pulses for square-wave testing; others may not. In either case, these pulses are so short that it may be difficult to analyze low-frequency response.) Regardless of the method used to produce the square wave, it should be given a "trial run" on a receiver known to be in perfect operating condition before attempting it on a set which is malfunctioning.

#### Square-Wave Analysis

After the test equipment is connected and the necessary adjustments have been made, it is advisable to examine the output of the video detector. The waveform at this point will be very similar to the output of the square-wave generator, if the receiver is properly aligned and the signal levels are correct.

Then, the signal is simply traced toward the CRT. When the waveform undergoes a change in shape, the area in which the fault is located has been isolated. The manner in which the waveshape has been distorted will provide an indication of

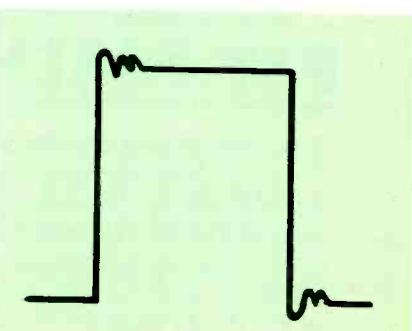
the specific component which is causing the trouble.

Fig. 10 shows a family of waveshapes. Fig. 10A is a normal square wave, but since these drawings were made from oscilloscope patterns obtained under laboratory conditions, some departure from the ideal waveshapes can be expected.

Fig. 10B shows the effect of increased low-frequency response (below about 200 KHz). Note that the top of the waveform rises at the right end, a condition known as tilt. This could be caused by a plate-load resistor which has increased in value. In the raster, this distortion produces positive streaking. This is a condition wherein a white horizontal bar is followed by a light streak, and a black bar is followed by a dark streak. The symptom will be most pronounced if the horizontal bar extends about halfway across the screen.

In Fig. 10C the top of the square wave falls at the right end. This indicates a loss of low-frequency response. Likely causes are a coupling capacitor or cathode bypass capacitor which has decreased in value; or, a resistor which bridges a coupling capacitor (R3 in Fig. 5) might be open or off tolerance. This fault causes negative streaking in the raster. (Black follows a white bar, and white follows a black bar.)

Figs. 10D and 10E show the effects of impaired high-frequency response and excessive high-frequency response, respectively. Since the tops of the square waves are flat (no tilt) the low-frequency plate-peaking coil (L1 in Fig. 3) is a possible cause of poor high-frequency response; or, if it were



**Fig. 11** Effect of ringing on a square wave.

shunted with a resistor, an open coil could cause this symptom.

A resistor shunted across a peaking coil could be open if the high-frequency response is too great.

In the raster, reduced highs result in loss of definition (smearing). Increased highs cause a "grainy" picture. In extreme cases, "edge effect" may result. This appears as a white outline to the right of black objects, and a black outline to the right of white objects.

Fig. 10 shows the condition called "ringing." The effect on the raster is similar to the effect of high standing-wave-ratio in the lead-in, (multiple ghosts). The most likely cause is an improperly terminated delay line.

#### Summary

Because the video amplifier of a color receiver is much more sophisticated than its monochrome counterpart, it is more vulnerable to failure. At the same time, its performance must be maintained as nearly perfect as possible, since the requirements for good color reproduction depend, to a great degree, on the luminance channel.

Generally, plate-load resistors and grid resistors of video amplifiers are of smaller value than their counterparts in audio amplifiers. This makes it necessary to increase the value of the coupling capacitor. In some cases direct coupling is used to further improve low-frequency response. Peaking coils are used to improve the high-frequency response.

In servicing the video amplifier, observation of a square wave usually will lead to a fast diagnosis of the trouble. Problems are evidenced by a change in tilt of the square wave, and the component at fault must be one that controls this part of the overall response. Edge effect, smearing, and ringing are caused by the components which affect high-frequency response, most often the inductances.

In the final analysis, a thorough understanding of how each component affects the operation of the video amplifier, coupled with logical isolation techniques, will make troubleshooting the video amplifier a relatively simple task. ▲



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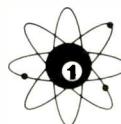


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# Servicing solid-state TV is different

by Robert G. Middleton

## Physical and electrical differences require new or modified servicing techniques.

Almost every technician is now, or soon will be, confronted with the problems of solid-state TV servicing. Troubleshooting transistor-TV circuitry involves some new approaches, compared with localizing and repairing tube-type TV circuit defects. The chief reasons for these differences are as follows:

1. DC operating voltages are usually much lower in transistor circuits, than their tube-type counterparts. On the other hand, DC currents may be considerably greater.
2. AC pulse voltages in sweep circuits are generally very low in transistor circuits, compared with tube-type sweep circuits. However, the AC pulse currents are often very large, by comparison.
3. The base of a transistor draws DC current continuously, except in a few specialized cases. By way of contrast, the control grid of a tube seldom draws DC current, except in a few specialized cases. These facts are implied by the statement that a transistor usually has a very low input impedance, whereas a tube usually has a very high input impedance.
4. Because of nonlinear junction characteristics, resistance measurements are not nearly as useful in analyzing transistor-circuit defects as they are in localizing tube-circuit defects.
5. Transistors are commonly tested in-circuit because they are rarely plugged into sockets, as are tubes.
6. There is considerably more danger of damage to transistors than to tubes in case of accidental short-circuits. The

same observation applies to surges resulting from quick-tests, such as bridging a suspected electrolytic capacitor by a new capacitor.

7. Test-equipment requirements are different in some cases; for example, a DC voltmeter should have a first range of 1 volt full scale, or less. A capacitor tester must not apply excessive test voltage to electrolytic capacitors. Generators must have blocking capacitors in their output leads.

### Comparison of DC Voltage Values

The DC voltage values in transistor RF tuners are very different from those in tube-type tuners. Figs. 1 and 2 show the electrode voltages for a 6FH5 tube in an RF tuner, compared with the electrode voltages for a 2SA290 transistor. Note that the plate voltage of the tube is about 80 times as high as the collector voltage of the transistor.

Next, compare the DC voltages at the electrodes of the tube and transistor in the IF stages in Fig. 3. The plate of the 6BZ6 operates at about 8 times the voltage applied to the collector of the 2SA70. Also, the cathode of the tube operates at about  $\frac{1}{3}$  of the voltage applied to the emitter of the transistor.

Observe the comparative voltage values shown in Fig. 4. The emitter-follower stage in Fig. 4B operates with a collector voltage of 10.2 volts, compared with a plate voltage of 115 volts for the video-amplifier tube in Fig. 4A. The difference in operating voltages is less in the transistor video-output stage; that is, the collector operates at 90 volts, which is relatively close to the 115 volts on the plate of a video-output tube.

Also note that the picture tubes used in transistor TV receivers generally operate at lower electrode voltages, except that the second-anode voltage is necessarily the same for a given screen size.

It can be seen in Fig. 5 that the DC voltages for a transistor keyed-AGC stage are quite different from the voltages in its tube counterpart. Similar differences could be cited for AGC amplifier circuits, horizontal and vertical sync sections, horizontal and vertical oscillator stages, horizontal and vertical sweep systems, and intercarrier sound and audio configurations.

To summarize briefly, comparatively low DC voltage values throughout transistor-TV receiver systems is the main concern. Also, in some cases a low-range DC voltmeter must be used; for example, the normal base-emitter voltage in Fig. 3B is 0.1 volt.

### Comparison of DC Current Values

As might be expected, a transistor circuit may draw more DC current than a comparable tube circuit. Power is equal to voltage multiplied by current, and if the operating voltage is low, then the operating current must be high in order to produce a given amount of power.

In Fig. 6A, a 6DQ6B tube is used to scan a larger raster, and the cathode current is approximately 130 ma. On the other hand, a transistor is used in Fig. 6B to scan a small raster, but the emitter current is approximately 240 ma.

Another striking example is found in a comparison of transistor and tube-type vertical-output arrangements: The transistor draws 1 ampere of emitter current, whereas a tube in a comparable configura-

tion draws 47 millamps of cathode current.

### Comparison of AC Pulse Voltages

Considering the foregoing examples, it is not surprising to find that AC pulse voltages in transistor stages are usually much smaller than those in their tube counterparts. For example, in Fig. 6B, the transistor driving pulse has a normal amplitude of 6 volts p-p, whereas the tube driving waveform in Fig. 6A has an amplitude of 115 volts p-p.

Even a greater disparity is found in pulse voltages for keyed-AGC circuits. For example, a transistor

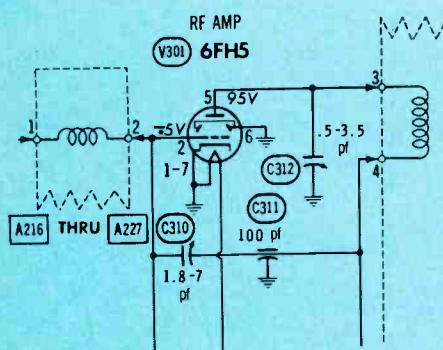
is typically keyed by an 8.5-volt p-p pulse, whereas a tube uses a typical keying voltage of 440 volts p-p.

In other cases, AC pulse voltages are about the same in both transistor and tube configurations. For example, the sync-pulse voltages are approximately the same in Fig. 4. On the other hand, do not suppose that these two video-amplifier circuits operate in the same way. The operating differences can be summarized as follows:

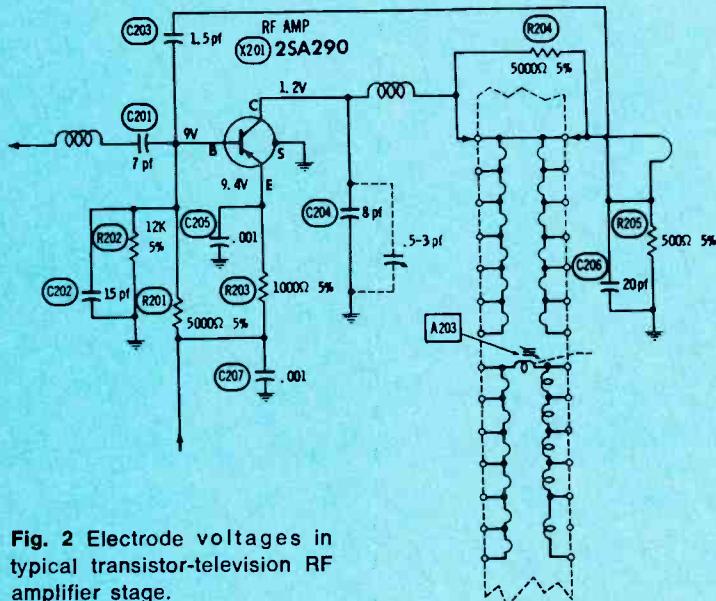
1. Although the control grid of the tube draws practically no pulse current, the base of the transistor draws substantial pulse current.
2. Since impedance is equal to

the ratio of AC voltage to AC current, it is evident that the input impedance of the transistor is much lower than the input impedance of the tube.

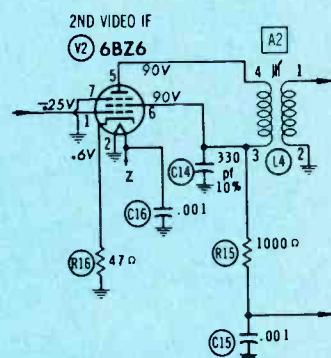
3. The low input impedance of Q5 in Fig. 4B requires the use of a driver stage that can supply appreciable signal current. Therefore, Q4 is employed as an emitter-follower (analogous to a cathode follower).
4. In most cases, the output impedance of a transistor is lower than the output impedance of a tube. This is due to the low ratio of collector AC voltage to collector AC cur-



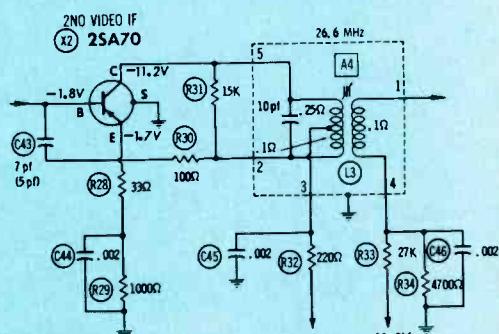
**Fig. 1** Electrode voltages in typical tube-television RF amplifier stage.



**Fig. 2** Electrode voltages in typical transistor-television RF amplifier stage.



(A) Tube video IF stage.



(B) Transistor video IF stage.

**Fig. 3** Comparison of electrode voltages in tube and transistor video IF stages.

rent, and also to the comparatively high value of collector junction capacitance.

- Because transistor junctions have appreciable capacitance, peaking-coil inductances are much smaller in transistor video amplifiers than in comparable tube-type circuits.

### Resistance Measurement Difficulties

A tube does not draw current unless sufficient current flows through its heater. On the other hand, a transistor has no heater, and the transistor will draw current whenever a forward voltage is applied across a junction. Because of this characteristic, and because an ohmmeter applies voltage to the circuit or device under test, trouble analy-

sis by resistance measurements in transistor circuits is not often practical.

A transistor junction is nonlinear, as depicted in Fig. 7. Because of this, an ohmmeter reading of junction resistance is very unpredictable—we usually do not know exactly how much voltage is being applied by the ohmmeter, nor the exact amount of current that will be drawn.

Troubleshooting would be simplified if transistors could be unplugged from sockets, as tubes are unplugged. However with few exceptions, it is customary to solder transistors into their circuits, with the result that appropriate test procedures must be employed by the technician to contend with nonlinear junction resistances.

Suitable test methods include:

- DC voltage measurements,
- Control-action tests,
- Signal-tracing procedures,
- Signal-injection procedures.

### DC Voltage Measurements

After picture and sound analysis have localized the cause of a trouble symptom to a particular section of the receiver, DC voltage measurements are the most useful guide in analysis of circuit action and in the pinpointing of defective components.

For example, suppose that sound reproduction is normal, but picture reproduction is poor, with low contrast and a normal raster. With reference to Fig. 4B, these symptoms throw suspicion on the video-output stage. If the emitter, base, and

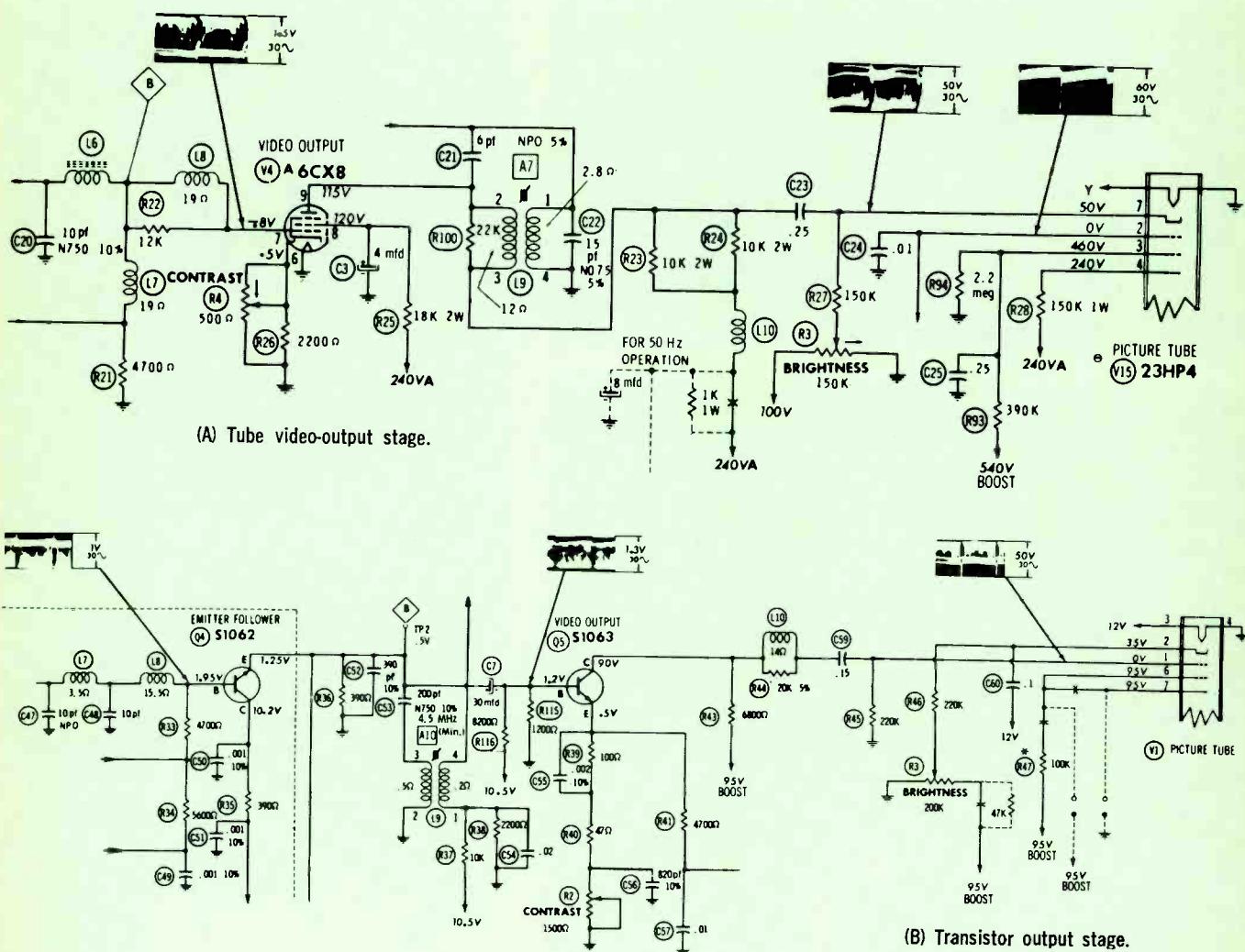


Fig. 4 Comparison of electrode voltages in tube and transistor video-output stages.

collector DC voltages of Q5 do not measure close to 0.5, 1.2, and 90 volts, respectively, the trouble probably would be found in this stage. The receiver service data or Sams PHOTOFACt is the best guide in this respect.

Incorrect voltages at the transistor electrodes do not necessarily mean that the transistor is defective; it is also possible that a capacitor is leaky or shorted. Although resistors do not change their values often, this also can happen. Therefore, we must evaluate the abnormal DC voltage distribution in an attempt to narrow the number of suspects. Since seemingly logical conclusions are not always absolute, check your reasoning by testing individual components, such as capacitors. In most cases, one end

of a capacitor must be disconnected for accurate testing.

### DC Voltage Distribution

It is helpful to understand the basic principles of DC voltage distribution in transistor circuits.

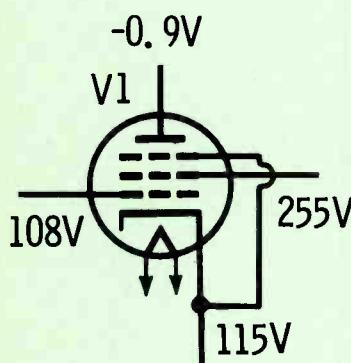
For example, Fig. 8 shows an NPN transistor in a typical IF stage configuration. For a better understanding of DC voltage distribution, consider the simplified circuit shown in Fig. 8B. Tabulate the DC voltage distribution in this example:

Emitter-Ground . . .	—4.5 volts
Base-Ground . . . . .	—4.3 volts
Collector-Ground . . .	0 volts
Emitter-Base . . . . .	—0.2 volt
Collector-Base . . . . .	—4.3 volts

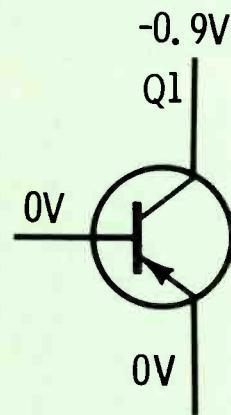
One of the most common transistor defects is leakage from collector

to base (leakage through the collector junction). In the first analysis, this leakage affects the DC voltage distribution as if a resistor were connected between collector and base, as shown in Fig. 8C. The junction leakage resistance draws current from the voltage divider that biases the base of the transistor, and the base voltage decreases. This decrease of base-voltage also affects the emitter voltage in the following manner:

1. A decrease in base voltage increases the emitter-base bias voltage;
2. An increase in emitter-base bias voltage causes the collector current to increase;
3. Since the increased collector current flows through the emitter resistor, the voltage



(A) Tube keyed-AGC stage.



(B) Transistor keyed-AGC stage.

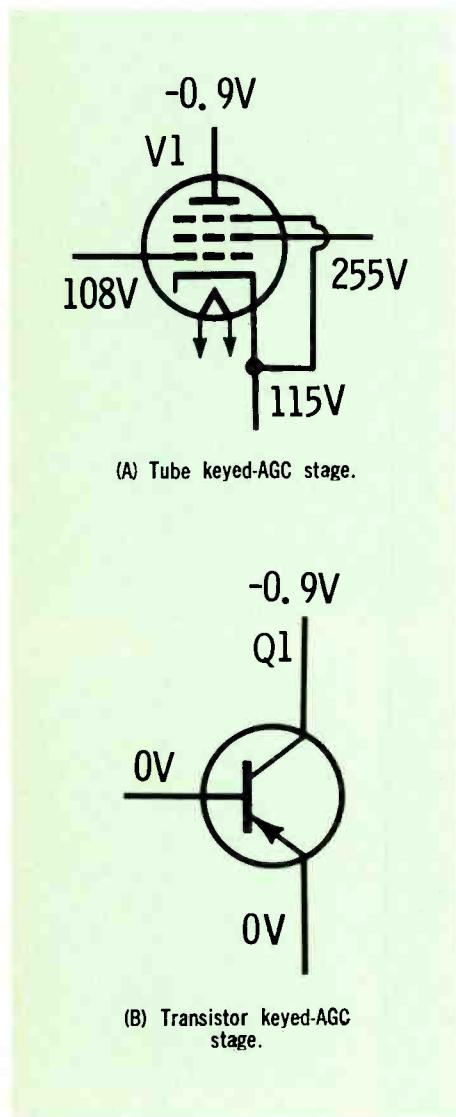
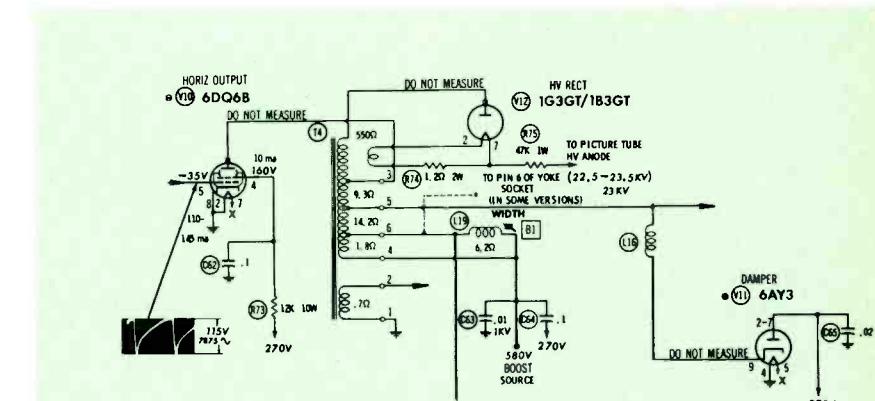
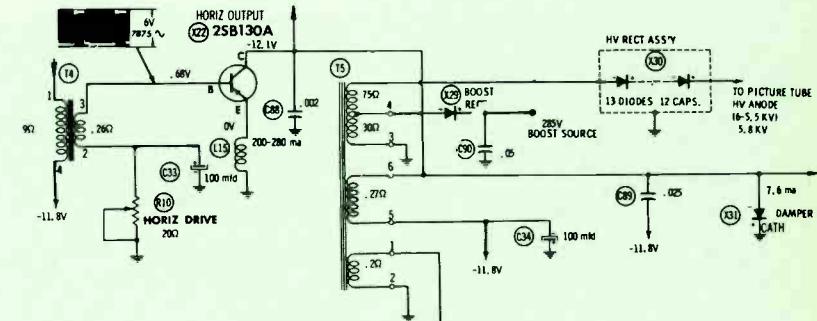


Fig. 5 Comparison of electrode voltages in tube and transistor keyed-AGC stages.



(A) Tube horizontal-output stage.



(B) Transistor horizontal-output stage.

Fig. 6 Transistor draws more current than tube in these horizontal-output stages.

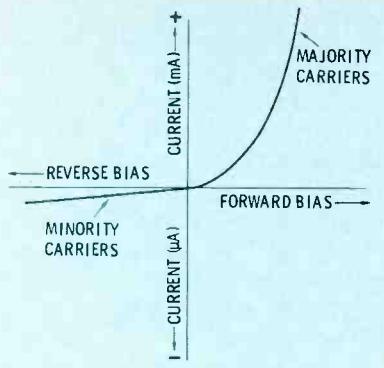
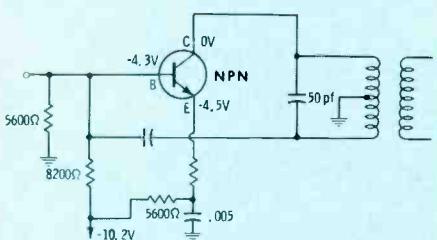
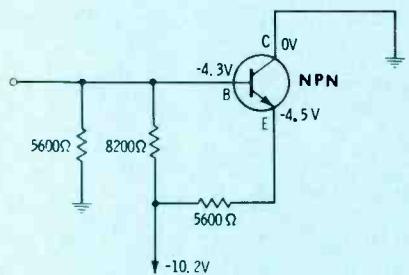


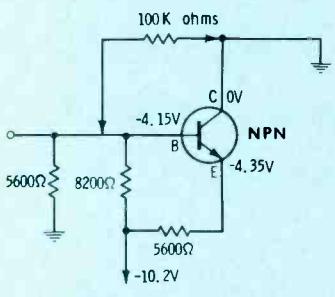
Fig. 7 Plot of current through and voltage across a PN junction.



(A) Typical circuit.



(B) Equivalent DC circuit.



(C) Equivalent DC circuit with collector leakage.

Fig. 8 Transistor IF circuit.

drop across the emitter resistor increases;

4. An increased voltage drop across the emitter resistor causes the emitter voltage to decrease.

In the example of Fig. 8C, the 100K leakage resistance between collector and base causes both the emitter voltage and the base voltage to decrease by 0.15 volt. Therefore, the emitter-base bias voltage remains unchanged, although the transistor is drawing more current. If the leakage current becomes excessive, the collector junction will overheat. The transistor then becomes open or shorted, and the stage is dead. Moderate amounts of junction leakage generally cause gain reduction in a stage.

### Open and Shorted Collector Junctions

Consider the effects on the DC voltage distribution in Fig. 8B if the collector junction becomes short-circuited. The base voltage will be zero. Since the emitter-base junction has a very low forward resistance, the emitter current is nearly equal to the supply voltage divided by the emitter resistance, or 1.8 ma (in accordance with Ohm's law). The emitter-base bias voltage will rise somewhat above its normal value of 0.2 volt, but the emitter-base junction will not be damaged.

Next, let us suppose that the collector-base junction in Fig. 8B opens up. In this case, the collector current will not load the bias cir-

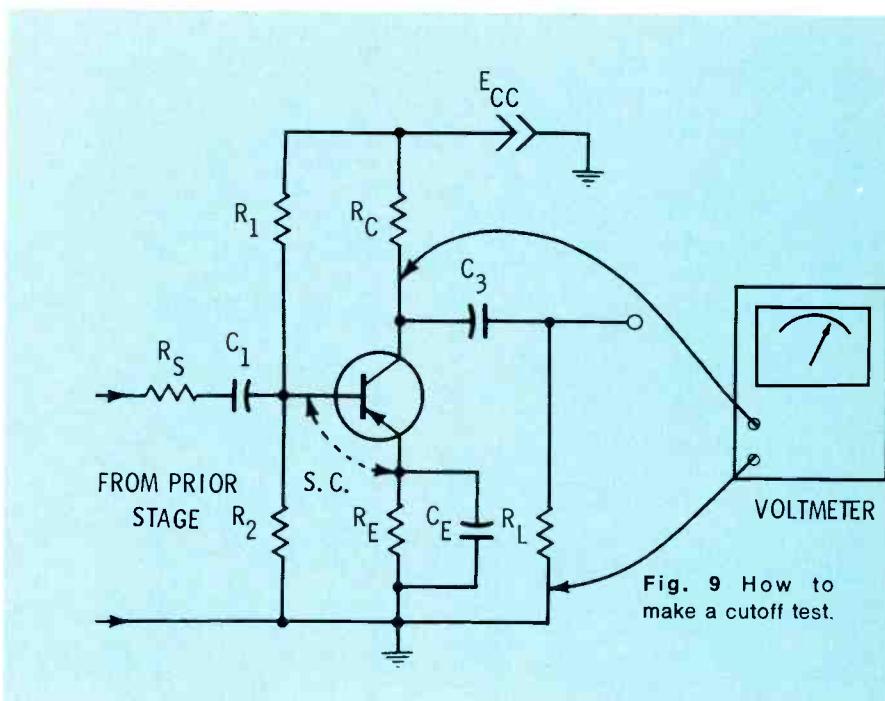


Fig. 9 How to make a cutoff test.

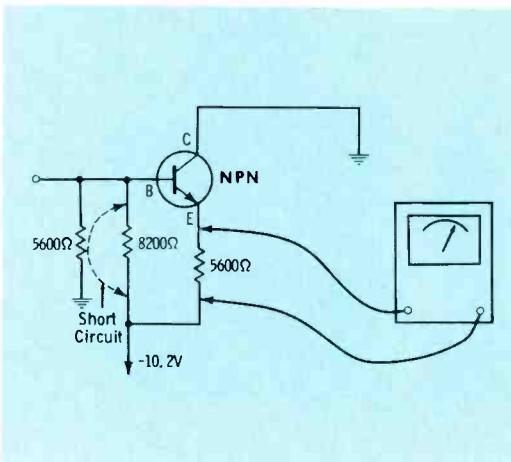
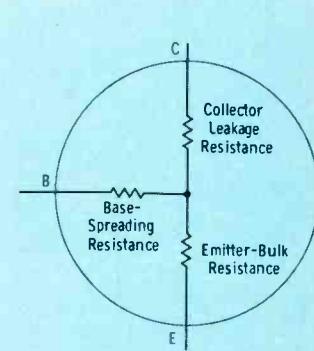


Fig. 10 Cutoff test setup.

Fig. 11 Equivalent circuit for a transistor with collector-junction leakage.



cuit, and the emitter voltage will rise to —6.5 volts. Accordingly, the emitter-base bias will remain normal, and the emitter-base junction will not be damaged.

To summarize briefly, collector leakage or open or shorted collector junctions cause abnormal DC voltage on other electrodes of the transistor. A collector-junction defect causes the emitter and base voltages to be either too high or too low.

#### Control-Action Test

Control-action tests, also called "turn-on" and "turn-off" tests, are often practical, and are very informative when the normal operating voltages of a transistor are unknown. They also can be useful supplementary tests, even when normal operating voltages are known.

#### "Turn-off" Test

A cutoff, or "turn-off", test is performed simply by cutting off the base current and checking the voltage drop across the collector resistor, or from collector to ground. For example, to perform a cutoff test of the transistor in Fig. 9, apply a short-circuit between base and emitter. This makes the base and emitter assume the same potential. This normally cuts off the transistor, causing the collector voltage to rise to the supply voltage, or Ecc, as indicated by the voltmeter.

If the voltmeter does not indicate Ecc in the cutoff test, assume that the collector junction is leaky. Of course, C3 could be leaky, and this possibility must be checked before replacing the transistor.

Next, apply the same basic cutoff test to the configuration in Fig. 8A. However, since the circuit does not employ a collector-load resistor, as is obvious from the equivalent DC circuit shown in Fig. 8B, a slightly modified test procedure is employed.

Referring to Fig. 10, short-circuit the 8200-ohm resistor, and check the voltage across the 5600-ohm resistor. Since the collector current is normally cut off in this test, zero voltage normally would be measured across the 5600-ohm resistor. However, if collector-junction leakage is present, a small voltage drop across the 5600-ohm resistor would be measured. The reason for this is seen in the equiva-

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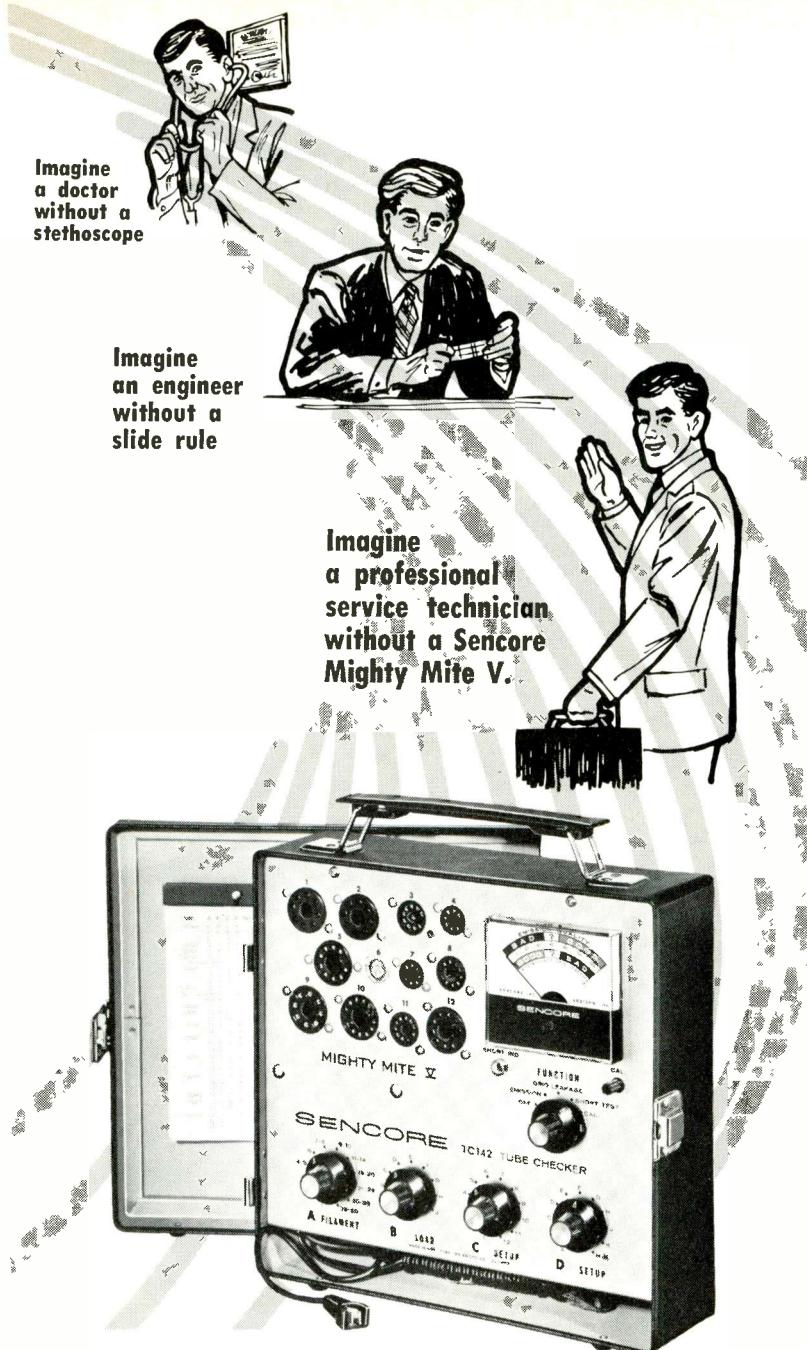
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lent T circuit for a transistor as in Fig. 11.

If the collector junction leakage is essentially an open circuit (normal condition), no current will flow from the collector into the base-spreading resistance and the emitter-bulk resistance. However, if collector junction leakage is measurable, the current flows into the base and emitter branches, and 0.02 volt will be read, instead of zero volts in the test of Fig. 10.

Since it is occasionally necessary to read very small values of DC voltage, a voltmeter with a first range of 0.25 volt full scale will provide maximum utility for the technician.

#### "Turn-On" Test

A "turn-on" test is another type of control-action test. It is less informative than a cutoff (turn-off) test, because it does not provide an all-or-nothing indication. A turn-on test is a helpful supplement to other tests, as it can confirm prior conclusions.

To understand the turn-on test, refer to Fig. 8B. If a DC voltmeter is connected across the 5600-ohm resistor, the voltage drop, due to collector and base-current flow, will be measured. This is 5.7 volts. Next, if a 100K resistor is connected temporarily from collector to base, as shown in Fig. 8C, the collector will normally draw more current, and the drop across the 5600-ohm resistor will increase. This is an increase from 5.7 to 5.85 volts, or a difference of 0.15 volt.

#### Accidental Short-Circuits

Avoid random short-circuit tests, because transistors are easily damaged. For example, if a clip lead is used in the Fig. 8C test, the transistor would immediately be burned out. Again, if the high voltage is arced in the flyback circuit, it is very likely that the horizontal-output transistor will be ruined. Any short-circuit that causes excessive base-emitter current to flow will burn out the collector junction. Therefore, avoid surges, which are often caused by shunting a decoupling capacitor or a filter capacitor with a new electrolytic capacitor.

#### Test-Equipment Requirements

Generators used for signal-injection tests or alignment must have

blocking capacitors in their output leads. This precaution avoids disturbance of base-emitter bias voltages because of DC drain-off.

Scopes used in signal-tracing tests should be provided with low-capacitance probes, to minimize circuit detuning.

Capacitor testers must not apply excessive test voltage to the low-rated capacitors employed in transistor circuitry.

In-circuit capacitor testers designed for transistor circuits have some degree of usefulness as well as in-circuit transistor testers, particularly when unusual configurations make control-action tests impractical or impossible.

Flyback checkers used in tube circuits cannot be employed in transistor circuits, because the component values and impedances are widely different. However, the same pattern generators and color-bar generators used to test tube-type receivers are used to test transistor receivers. Some modern tube testers also provide transistor-testing functions. However, if your tube tester is conventional, you will need to supplement an in-circuit transistor tester with an out-of-circuit tester. A high-voltage DC probe is an essential accessory for your VOM or VTVM.

### Conclusion

We have reviewed the differences between the servicing procedures used for solid-state and tube-type TV receivers. These differences are reflected in some of our test-equipment requirements. Transistors cannot be easily replaced, and greater reliance must be placed on DC voltage measurements.

Control-action tests are very useful. Since transistors are more easily damaged than tubes, random short-circuits and high-voltage arcing are off-limits. Resistance measurements are less useful in transistor circuits than in tube circuits, due to nonlinear junction resistances.

The transistor-TV technician needs to have a good working knowledge of Ohm's law, and he can save time if he is familiar with DC voltage distribution in resistive networks.

A VOM is quite practical for nearly all transistor-circuit troubleshooting, because circuit impedances are comparatively low, with very few exceptions. ▲

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## NATESA

### ORGANIZATION

The National Alliance of Television and Electronic Service Associations (NATESA) is comprised of local, state, and regional associations of electronic service businesses (and individual service businesses in areas where no NATESA-affiliate exists). Only one local association from each city and only one association from each state may join.

The administrative office of NATESA is located at 5906 S. Troy St., Chicago, Ill. Administrator and principal spokesman is Frank Moch, executive director. The executive director is selected every two years by the executive council.

Association officers (who with the executive director comprise the executive council) are: President, Clifford A. Shaw, Richmond, Va.; secretary general, Jean P. Lash, Oak Park, Mich.; treasurer, Tom Easum, Memphis, Tenn.; four re-

# NATIONAL ASSOCIATIONS OF THE SERVICING INDUSTRY

**Spokesmen for NATESA and NEA discuss goals and activities of their organizations, some industry trends, and problems common to those engaged in the electronic servicing industry \***

## NEA

### ORGANIZATION

The National Electronic Associations, Inc., (NEA) is an affiliation of state electronic service associations. Its president and principal spokesman is Dick Glass, 7046 Doris Dr., Indianapolis.

The headquarters office is 4622 E. 10th St., Indianapolis, Ind., (the business location of NEA's secretary, Leon Howland).

Other officers are: Treasurer, Homer Davidson, Ft. Dodge, Iowa; and eight regional vice presidents—Warren Baker, Albany, N.Y.; Warren Gill, Albany, Ga.; Kenneth Young, Washington, Iowa; Ray Demmonbrun, Louisville, Ky.; Charles Enyeart, Lincoln, Nebr.; Norris Browne, Houston, Texas; Colin Gregory, McMinnville, Ore.; and Emmett Mefford, Fontana, Calif.

The NEA president explained that much of the administrative work is done by the committee chairmen, and that the regional vice-presidents make up part of the association's "working group." They help make day-to-day decisions, along with the secretary, treasurer, president and immediate past president.

The presidents of the affiliated

\*A recent survey of *Electronic Servicing* readers showed that of those responding to a question on membership in service associations, 76 percent were not members of any service association.

gional vice presidents—(Eastern) Leo Shumavon, Boston, Mass.; (East Central) Richard Knautz, Galena, Ill.; (West Central) Eugene Decker, Kansas City, Mo.; and (Western) Clyde W. Ellis, Seattle, Wash.; and divisional secretaries—(Eastern), Earl Gove, Jr., Bristol, Vt., (East Central) Donald Long, Davenport, Iowa; (West Central) Howard W. Wiggs, Wellsville, Mo., and (Western) Alan W. Danielson, Santa Fe, N.M.

#### OBJECTIVES

NATESA's declared goal, as voiced by its executive director, is "the improvement and perpetuation of independent electronic service businesses." To attain this, NATESA acts to serve and promote proprietors of service businesses, encourages them to adopt a code of ethics, and then stresses this code publicly to improve the image of the electronic service business. NATESA also encourages indepen-

dents to improve business and technical capabilities, openly denounces manufacturers' practices that NATESA believes detrimental to independent servicers, provides a voluntary certification program for technicians, and promotes legislation and training.

#### Requirements for Membership

Members must be proprietors of duly established service businesses which comply with the following standards:

Employ only qualified technicians, maintain proper test equipment, itemize all bills, properly identify place of business to the public, comply with all local state, and federal laws. . . . , be of good character and assist in any reasonable investigation of qualifications.

Membership varies, but in the past has been as high as 5,500, including individual members. The largest concentration of members can be found in the midwest, es-

pecially Illinois, Michigan, and Wisconsin.

**Origin**—NATESA was founded in 1950 after about two years of preliminary organization.

**Publications**—NATESA's official publication is a monthly magazine, SCOPE. The association also publishes bulletins and pamphlets.

#### ACCOMPLISHMENTS

"We have elevated the image of the service people."

"We have made service people aware of the need for knowing costs."

"We have attempted to instill in our members the desire to keep up to date on technological aspects of the business."

The above affirmations were the response of Frank Moch to the question: "What do you consider to be the most solid accomplishments of NATESA?"

The activities referred to above can be categorized as 1) Public

state associations comprise NEA's board of directors. "We like to think of NEA as being directed by the affiliated state associations, rather than by national officers or by local associations. If there are decisions to arbitrate, the state leaders act to come up with the conclusions. They vote by delegate strength. For example, Georgia, with 30 members, casts 30 votes; and, California, with 300 members, casts 300 votes. This is the way final decisions are made," Glass explained.

Current membership is about 1,200. Glass indicated that since many of these are shop memberships and include more than one technician, it can be assumed that about 3,000 technicians are actually members of the NEA. Membership dues are \$12 annually, plus a one-time initiation fee.

It is optional with each state association whether or not its members are also members of the NEA. For example, of the 800 members of the California affiliate (CSEA), only about 300 members are also NEA members.

However, all members of some state associations are also members of the national association.

The only requirement of an individual member is that the applicant be engaged in the home electronics industry—and membership includes retailers, service dealers and sales personnel as well as technicians.

**Origin**—Founded in 1963 by a dissident group within NATESA, which broke off from that group.

**Publications**—A monthly magazine, ELECTRONIC SERVICE DEALER, and service pamphlets and bulletins.

#### OBJECTIVES

The stated purpose of the NEA is "To upgrade the electronic technician and improve the business of electronic servicing." It is basically oriented to serve, train and upgrade the capabilities of the individual technician, whether he be shop owner or employee. Through its CET (Certified Electronic Technician) program, the NEA tests technicians, and awards certificates and wallet cards to the technicians who qualify. The organization has also been active in promoting licensing legislation and in training.

Look at the letterhead of the National Electronic Associations, and you get a quick overall view of

NEA's objectives—its areas of concern in this industry. The letterhead lists:

Public Relations  
Business Management  
Technical Information  
Legislative Advisement  
TV-Radio Station Liaison  
Apprenticeship & Training  
Distributor-Mfr. Relations  
Certification of Electronic Technicians (CET)

Were you to ask a knowledgeable but impartial observer of the NEA to underline three areas of concern in which the association has made the most solid accomplishment, he might quickly draw lines under Public Relations, Apprenticeship & Training, and Certification of Electronic Technicians.

Dick Glass, in an interview with ELECTRONIC SERVICING, discussed NEA's objectives, and what is being done to reach them:

**Public relation**—"There are two aspects to this: a broad, national, industry-wide level performed by NEA officers; and the individual, local level performed by the member technicians.

"The president and secretary of

## NATESA

Relations, 2) Business Management, and 3) Technical Training. Moch elaborated on each:

1) **Public Relations**—"We have had an eagle-eye out for articles that are critical of service technicians. We have challenged these articles by letters, telephone personal visits or other means of communications." Moch said that his efforts have included TV appearances in Chicago, and more recently he has been "cultivating columnists in the press."

On one occasion, he challenged the then attorney general of Illinois for allegations detrimental to the reputation of electronic technicians in general.

NATESA has also published two brochures for distribution to the public which cite the serviceman's role: "Joys of Electronic Living," and "So This Is Television."

In order to help improve the image of its members, NATESA

adopted a code of ethics, and urges members to abide by it.

2) **Business Management**—"We have educated them on costs and other business problems in many ways." He said NATESA used a series of films on pricing and other management subjects.

3.) **Training Technicians**—"We have encouraged the members to keep up-to-date on technological aspects by using Sams' slides and publications on transistors, for example, and by encouraging them to invite factory personnel to give training sessions." NATESA developed a "mini-course" Moch said, on the subject of radiation and picture-tube implosion. Those who passed this course were awarded a "safe-servicer certificate."

### OTHER ACTIVITIES

**Watching Industry Trends**—Watching trends by the manufacturers that might affect the independent has been a constant activity of

NATESA. NATESA's executive director comments on recent innovations on warranty and factory service centers:

**Warranty**—"First of all, let's say that the buyer of a product is completely entitled to protection. Protection in that the product he has bought has no defects either in components or in engineering. This is the inalienable right of the buyer. The manufacturer should be responsible for not only the part but for labor. We made a national study which indicated that in a period of 90 days a set is used from 500 to 1500 hours, which would indicate the set would have been used under any imaginable kind of usage—that it had been put through its paces—that any inherent defect would have shown up in the average set. Taking the basic figure of 500 hours, this made it a legitimate warranty.

"Now, when the manufacturer goes beyond 90 days, and when the

## NEA

NEA act as national spokesmen on things that affect the serviceman. They act as 'the Great White Father' in protecting technicians as a group from undue criticism. The technician has a tough job technically, and he has a tough job in constantly confronting the public," Glass said. NEA's efforts to ease

the latter task involve improving the technician's image.

"But, we must say that this image is not uniformly bad. A survey taken in one region showed that the public does not think the technician as lowly as the latter sometimes believes.

"But, it is still a problem that can and should be eased—beginning with the title of the man who services electronic products. We think he should be called 'electronics technician', not 'TV repairman.' The latter is not a prestige title," Glass says. He stresses that even the occupational title can affect the prestige and recognition of the men in this industry."

**Public Relations on Individual, Local Level**—NEA encourages technicians to distribute to customers NEA pamphlets which explain warranty, service procedures, and the role and responsibility of the technician. The pamphlets are considered as doing a public relations service for the technician who gives them to his customer and for the servicing industry as a whole.

Of this printed public-relations material, the "customer return

card" is considered by Glass as the best. It is given to the customer by the technician when he repairs a product and invites the customer to register a complaint with the NEA if service is not satisfactory. The card offers to the customer a third party to complain to—an arbitrator—Glass believes. He says that technicians are not using the card as much as they should.

The card also contains a space for the customer to indicate that service has been satisfactory. NEA receives many cards indicating "OK" service, and rarely receives cards with complaints about service, he said. But, just having the card and knowing that they can complain builds customer confidence in the electronic service industry, the NEA president stressed.

**CET Program**—This is a program that awards technicians a certificate and a wallet card after they pass a 125-question, written, multiple-choice test, and show proof of electronics schooling and/or equivalent experience.

NEA sees certification as a means to set a minimum level to be achieved; to give the customer some



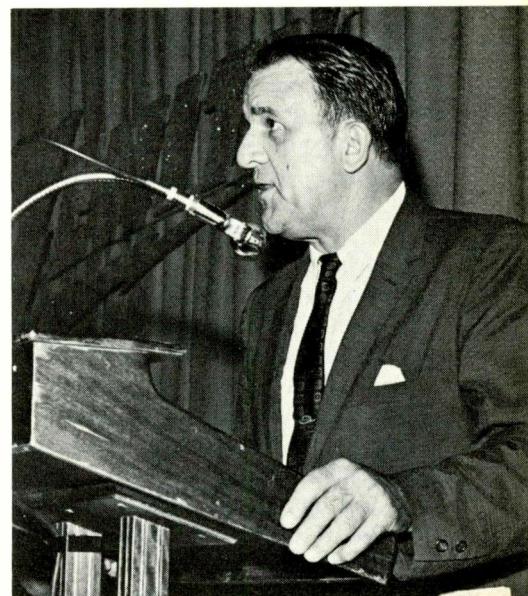
Dick Glass, president of the National Electronic Associations (NEA): "To upgrade the electronic technician and improve the business of electronic servicing."

manufacturer advertises the warranty as free, he is committing a fraud—for several reasons: Number one, obviously, nobody in business gives anything for free. Number two, no manufacturer knows how the set is going to be used over a period of two years. The manufacturer, by giving this extended warranty, is no longer warranting only inherent defects, he is also guaranteeing to replace parts that are being worn out. This is out of the realm of his business. By guaranteeing to replace parts, he is automatically in the insurance business."

**Servicing**—"He [the manufacturer] has entered a field completely alien to his basic operation. If service was so poor that they say they have to get into this field, there might be some justification. I have been in this business for over 40 years. If for 40 years, the manufacturer was supremely happy with independent service, with little help

from them, then this belies the claim that they had to get into it because there was not service help available. If service was not available, the sales of electronic goods would not be booming. We feel that the manufacturer is usurping our business."

**Problem of Pricing**—NATESA's executive director had these comments on the problem of pricing in the service industry: "It stinks. The federal law hangs over our heads. We tried to get the Federal Trade Commission (FTC) and the Justice Department to let us issue some form of pricing information. We offered several alternatives: We offered a bracketing of prices on an hourly basis, or on the basis of diagnosis of the symptoms, or on the basis of time per increment. We assured the FTC and the Justice Department that this rate schedule would be available to any servicer or anyone who wanted it . . . We



**Frank Moch**, executive director of the National Alliance of Television and Electronic Service Associations (NATESA): "The improvement and perpetuation of independent electronic service businesses."

means of judging a technician's qualifications; to help the employer judge a job applicant; and to give the technician an identification within the area where he works..

The tests can be administered by any NEA officer, CET, or other interested person who is authorized by the local technician group, state association, or NEA. The administrators of the test are charged with maintaining the integrity of the program. No time limit is set, but most applicants take about two hours. Grading of test papers is done by the International Correspondence Schools, a division of the International Textbook Corp., Scranton, Pa. The applicant must score 75% to pass.

The administration fee for the test is \$5 per applicant, with no charge for "retakes" by those who fail to pass on their first try.

Material covered by the questions include TV operation and troubleshooting techniques, FM, antenna, audio, alignment, and other "normal-knowledge" electronic problems.

The NEA has learned of one technical institute that offers a

course preparing candidates for the CET test.

There are now over 700 CET's in the U.S., and the number is growing. The program is open to any technician, whether or not he is affiliated with NEA or any other trade association.

The NEA's certification committee periodically revises the tests.

#### Distributor/Manufacturer Relations

—A survey on serviceability, recently inaugurated, and receiving considerable attention in the trade press, is one of the most distinct activities of NEA's committee on distributor/manufacturer relations. The purpose of the survey is "to concentrate on developing a series of national surveys to learn and record the problems involved in servicing new home entertainment electronic products"—and, to work with manufacturers in finding solutions.

Glass explains, "This is not a gripe committee, but a constructive effort to work with the manufacturers so that by simple adjustments the technicians can better service the products, and at less cost to the consumer. Often, a single test point can make the difference between

minutes and hours for the service technician."

The committee provides NEA members with a serviceability survey form, and later a compilation of information gained in the survey, giving details of serviceability problems reported. This committee is headed by Dean Mock of the Indiana affiliate.

**Business Management**—Direct engagement in this problem has been limited, Glass says, and has been principally involved in providing guidelines and counselling on pricing. However, NEA uses its national publication and other methods to publicize among technicians the clinics, seminars and institutes on management that apply to the industry.

**Technical Information**—NEA publishes a bulletin titled **Techni-tips**, which is sent monthly to members. The bulletin gives case histories of trouble symptoms and their causes and cures as obtained from NEA members and manufacturers' service literature. Forms are provided to members for reporting these symptoms.

**Apprenticeship & Training**—Over three years ago, the NEA, in co-

## NATESA

got a letter back from the Justice Department saying that no doubt our intentions were honorable, but it could possibly be perverted to the advantage of some group, and, therefore, they could not authorize it."

### LICENSING

Mr. Moch explained NATESA's philosophy and action on licensing:

"Both NATESA and I have been strong proponents of an enforceable system of codes—both as to business ethics and as to technical prowess. We had an organization of legislative experts prepare for us a licensing bill—a model bill—we studied it, and made some amendments to make it fit more our desires. This bill, then, was offered to all of our members. It had a dual purpose: To license both the service establishment and the individual technician. The service establishment would have to follow a code of advertising ethics . . . We

even prepared a code of advertising. We knew that we did not have the power to enforce it. We showed that code to the Chicago Better Business Bureau, which, in turn, referred it to the National Better Business Bureau. Today this basic code of advertising is recognized by Better Business Bureaus across the U.S.

"This would be part of the licensing of the shop: You have to maintain facilities, technical data, an advertising code of ethics, protection of the customer in case of damage to his property, and protection of funds paid on service contracts.

"The licensing of the individual technician would cover only his technical capability of servicing sets. It would be based on his ability to interpret cause and effect; for example, the effect of excess current, or a short circuit in a set, etc. We prepared a test having about 150 multiple-choice questions—ques-

tions about the frequency of a radio as opposed to a TV, etc., basic things that a technician should know.

### CERTIFICATION PROGRAM

NATESA has developed a voluntary technician certification program. It includes a series of 10 lectures, which is followed by a test for participants who attend the lectures. It is a multiple-choice test based on a series of 125 questions. Those who pass the test are awarded "electronician" certificates. (Electronician is a word coined and copyrighted by NATESA.) The tests are graded by NATESA's national office in cooperation with the affiliate that administers the test.

### ORGANIZATION

The association's annual convention is held in Chicago. This year it will be August 15-17 at the Pick-Congress Hotel. ▲

## NEA

operation with the U.S. Dept. of Labor, initiated an apprenticeship training program for electronics technicians. Glass was then NEA's director of training, and worked through NEA's affiliate state associations to promote formation of training classes. NEA was contracted by the Department of Labor to promote and initiate local training programs under provisions of the Manpower Development and Training Act of 1962. The program was organized in several states, but was later discontinued when a budget cut dried up federal funds. This committee works in conjunction with some trade and technical schools.

The latest aspect of NEA's involvement in training was explained by Glass:

"The Apprenticeship committee of NEA is working with the department of public instruction of the state of Indiana to develop a training course for public junior and senior high-school vocational classes in that state. The Indiana School authorities, who sought out the cooperation of NEA early this year, hope to begin enrolling top students in this course this year. It will in-

clude practical shop work as well as electronic theory."

The Indiana school authorities asked NEA to recruit the best students to enroll in the CET program once they have completed the course, Glass said.

**Legislative Advisement**—This committee advises state associations on state licensing, and provides for members, pamphlets and documentary reports of case histories of efforts made in promoting licensing laws through state or municipal law-making bodies. Last year, a one-day seminar on licensing was held in conjunction with the NEA board meeting. (Leon Howland, NEA's national secretary, is also chairman of the Indiana State Radio and Television License Board.)

**TV-Radio Station Liaison**—This is the area of least activity, but here are two examples of this liaison: The Indiana association had had an agreement with TV station WFBM, whereby the station displays the association's emblem on the screen, promoting its members as most capable technicians and, in return, technicians fix a sticker to customers' sets advising that if the WFBM signal is not good, to notify the sta-

tion's engineers. Also, an agreement has been reached with four radio stations in Illinois for their chief engineers to monitor CET tests in their cities.

### INSURANCE

A national hospitalization group insurance program for members of the NEA was adopted last October. (A schedule of benefits obtainable in this program was published in the March, 1969 issue of ELECTRONIC SERVICING.) The project, begun in early 1968, was made a reality after five insurance firms were given guidelines and invited to bid according to coverage and benefits set forth in a bid specification sheet. Two companies submitted bids. The Independence Liberty Life Insurance Co. was selected.

Some new members have joined primarily because of the insurance program, the NEA president said.

### ORGANIZATION

The fifth annual NEA convention will be held July 22-27 at Waterbury Conn., with headquarters at the Quality Courts Motel. The national convention chairman is George Dukas of Waterbury. ▲

**When we introduced the "original wedge" antenna in '67, we told you there'd be plenty more to come.**

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You see, we knew there had never been an antenna as different as our Color Wedge series of Super Colortron antennas.

And not just different. Dramatically different. In design, in performance and in construction. And since the differences can be dramatically shown, Color Wedge has arrived. Big!

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- A revolutionary built-in ferrite impedance stabilizer that increases gain 10%, with an automatic match.
- The utilization of booms as both supporting members and phasing lines.
- New truss construction that has given new meaning to the word "rugged."
- And, of course, they can talk about all the now famous Super Colortron features, including the built-in cartridge housing with its solid state preamplifiers.

The way it looks now, it will be a long time before anybody creates an antenna series that can compare with Color Wedge. And that's something to talk about, too. If you're a Winegard dealer.

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A complete line of 8 models.  
Shown: CW-96

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Circle 25 on literature card

# test equipment

notes on analysis of test instruments, their operation and applications

## Eico Model 385

### Color-Bar Generator

The Model 385 Colormate is Eico's most recent contribution to the assorted group of compact, self-powered, color-bar generators currently available to the servicing industry.



Compact size (8½" wide by 3" high by 8½" deep) battery-powered all solid-state circuitry, modulated RF output and five crystal-controlled test patterns plus separate gun-killer switches make the Model 385 particularly suitable for home-calls as well as shop use.

All operating controls of the color generator are located in a logical pattern on the faceplate of the instrument, as shown in Fig. 1. An easy-to-grasp, six-position function switch, located in the center of the faceplate, provides individual selection of the following b-w and color test patterns:

Horizontal lines (7)

Vertical lines (8)

Crosshatch (7 horizontal and 8 vertical lines)

Dots (56 dots, two scanning lines thick, not adjustable)

Keyed color bars (8, standard)

A picture of the test pattern available at each position of the function switch is provided for fast "one-glance" selection of the desired pattern.

The "off" position of the function switch removes all power from the generator circuitry to conserve the six "C" cell batteries used to power the instrument.

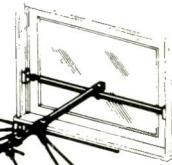
A control labeled "VERT HOLD," located on the left of the faceplate, adjusts the horizontal lines; and a control labelled "HORIZ HOLD," located on the

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Circle 27 on literature card

right of the faceplate, adjusts the vertical lines.

Separate slide-type, color-coded, gun-killer switches are located on the lower right of the faceplate. Activation of any one of the three switches grounds the control grid of the associated color CRT gun through one of three 100K-ohm resistors, disabling the gun for purity adjustments.

The resistors are built into a conventional color CRT socket that is permanently attached to the rear of the unit.

During lab testing of the generator it was noted that the gun-killer switches were a little tight, although repeated use did loosen them to some extent. Larger switches and increased spacing between them would have made them easier to operate, although the present design is adequate once you get used to it.

Both the CRT socket and the generator output leads are stored in a compartment at the rear of the generator. The batteries are also housed in this compartment. The cover of the storage compartment is a "snap-in" unit that at first seemed a bit awkward, but after a little practice the cover could be snapped into place on the first attempt.

#### EICO MODEL 385 SOLID-STATE Color-Bar Generator Specifications

##### Patterns

###### Color:

Keyed rainbow (8 standard color bars)

###### Convergence:

Crosshatch (7 horizontal, 8 vertical lines)

Dots (56 medium-size dots, two scanning lines thick)

Horizontal lines (7)

Vertical lines (8)

##### Outputs

###### RF:

Crystal-controlled, 61.25 MHz (Channel 3), 10,000 uv into 300 ohm load

No video output

##### Chroma Level

Fixed (not variable)

##### Power Requirements

Six "C" cell batteries (1½ volts)

##### Size (HWD)

3" x 8½" x 8½"

##### Weight

4½ lbs.

##### Price

Kit: \$79.95

Wired: \$109.95

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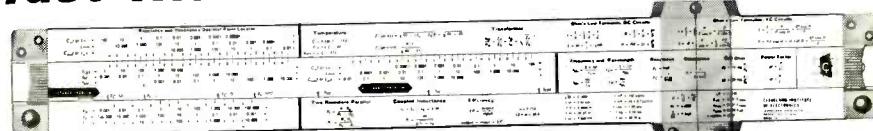
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# troubleshooter

## Intermittent Vertical Roll

An Emerson portable TV chassis 120758A displayed intermittent vertical roll with critical vertical hold and limited "lock-in" range. The vertical sync would hold for a short period, then slip into a slow vertical roll.

Before scoping the sync signals, I checked and/or replaced all tubes normally associated with this symptom, including the vertical oscillator, vertical output, sync separator and AGC/noise inverter. The trouble symptom persisted.

Horizontal lock was fairly stable; however, on occasions, when switching channels, the raster would slip out of horizontal sync. This strengthened my original diagnosis that the trouble was probably in the sync circuit.

Scoping the sync signals through the video output, AGC/noise inverter and sync separator stages verified that the video and sync signals were normal, with no noticeable distortion or compression of the sync.

Although I did not really suspect the vertical oscillator/vertical output stages, I did not overlook the remote possibility that improper loading could affect the sync signals. However, scope checks in these stages indicated that all waveforms were normal in both shape and amplitude.

All DC voltages from the tuner through the vertical output stages were normal.

The sync and integrator modules (printed components) were checked by substitution, but had no effect on the trouble symptom.

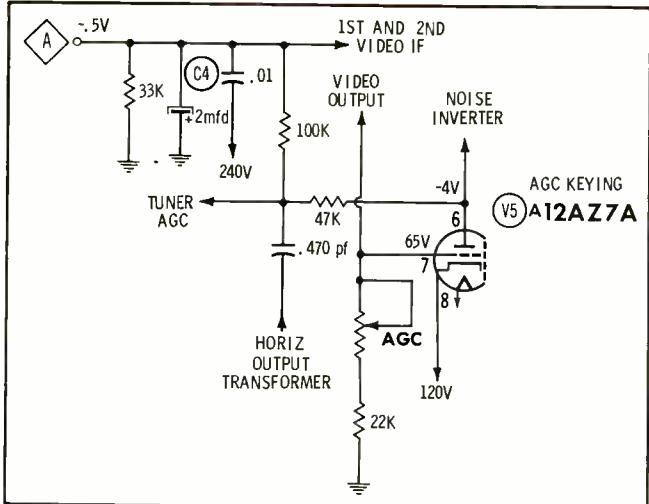
The next step was to check all filters and decoupling circuits. Poor filtering would allow contamination (noise, hum, transients, etc.) to enter the sync stages.

I bridged all filter and decoupling capacitors with a known good component. Finally, when C4, an AGC filter capacitor, was bridged, the trouble symptoms disappeared. Replacing C4 cured the problem.

MANUEL SAVIDIS

Franklin Square, NY

The purpose of C4 in the AGC line of this chassis is to filter out any low-frequency signals, such as vertical sync pulses, that are present on the line. Theoretically, no vertical sync pulses should be present on the distribution line of a keyed AGC system, since the tube is keyed on by horizontal sync pulses. However, some keyed AGC systems do respond to vertical sync pulses, as obviously this one does. When C4 decreased in value, its time constant was reduced to the point that it no longer filtered out the low-frequency, vertical sync pulses. The negative vertical sync pulses present on the AGC line effectively reduced or cancelled a portion of the vertical sync pulses in the composite video signal which is amplified by the video IF stages and video output. Thus,



the vertical sync pulses fed to the vertical oscillator were not of sufficient amplitude to lock the oscillator on frequency.

Use of the scope was a wise choice in this case, since the DC voltages, including the AGC voltage, usually are not upset by a defect such as this. Scoping the top of C4 would probably have produced evidence of the presence of negative vertical sync pulses on the AGC line.

In the description of your diagnostic procedure, you mentioned that there was no noticeable distortion or compression of the sync signals in the sync separator or video output stages. It is possible that the reduction in the amplitude of the vertical sync pulses was very slight. If the operation of the vertical oscillator was marginal to begin with, only a slight reduction in the vertical sync pulses would be required to upset it completely.

A leaky C4 would have reduced the AGC voltage and caused some overloading, the degree of overload depending on the amount of AGC voltage that was reduced. If the AGC bias is reduced enough to cause clipping of the sync signals in the video IF's, critical vertical and/or horizontal sync could result. However, your failure to mention any other trouble symptoms relating to overloading ruled out this possibility in my diagnosis of the trouble.

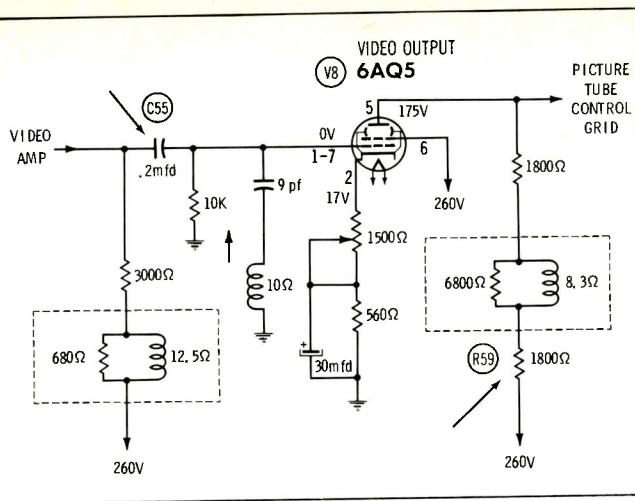
## Video Trouble

An RCA KCS 104H chassis exhibited a weak picture on all active channels except 2 and 4, which displayed overloaded pictures with unstable horizontal and vertical sync.

All tubes between the tuner and the video amplifier were changed, including those in the sync and AGC and noise canceller stages. The trouble symptom remained unchanged.

The waveform at the plate of the AGC tube was checked, but it was normal and offered no clues. However, the waveforms at the grid of the AGC keyer, grid of the noise canceller, grid of the sync separator and grid of the sync amplifier were all slightly distorted.

Voltage measurements revealed that the output of the low-voltage supply was lower than normal. Replacing the 504 low-voltage rectifier and bridging the



filters had no affect. The 504 rectifier was replaced with a silicon solid-state unit and the low voltage was increased to nearly 300 volts (slightly more than the normal voltage indicated in the PHOTOFACt folder).

After the receiver operated for a few minutes, the 1800-ohm plate load resistor (R59) of the video output stage overheated. Further voltage checks in this stage revealed that C55, the coupling capacitor between the video amplifier and video output stage, was leaking. Replacement of both C55 and R59 returned the set to normal operation.

FRANK FILIPPELLI

Forest Hills, NY

With C55 leaking, a portion of the video amplifier B+ voltage was applied to the control grid of the video output tube, causing it to conduct excessive plate current and burning out R59, which was probably marginal to begin with.

Although it is difficult to "second-guess" a situation such as you described without having more information, it is most probable that the leaky coupling capacitor and resultant extremely high conduction of the video output tube lowered or contributed to the reduction of the output of the low-voltage supply. It is also probable that the leaking coupling capacitor upset the operating condition of the video amplifier so that an inadequate or distorted composite video signal was fed to the AGC, noise canceller and sync separator stages.

When you increased the low voltage by replacing the 5U4 voltage rectifier with a solid-state unit, the extra low voltage aggravated and made more obvious the component defects in the video output stage, which, to begin with, were probably the cause of the trouble symptoms.

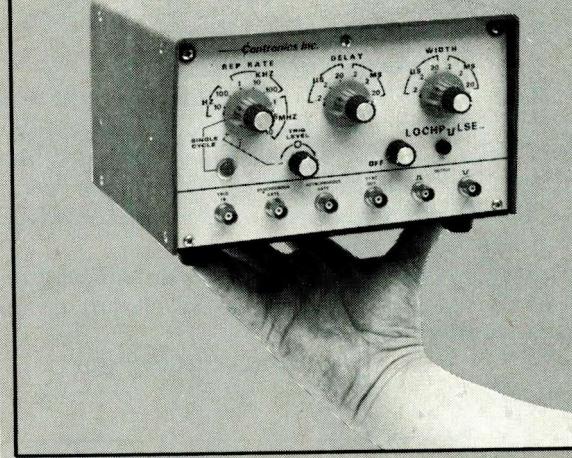
#### Dirty Tuner or Not?

A TV receiver that was purchased in August of 1968 displays heavy snow and a weak picture on one channel; other channels are normal. Do you believe that this trouble symptom is caused by dust in the tuner or do you think there is a mechanical defect involving the tuner contacts, solder connections or drum retaining spring, etc.?

A. L. FRANKLIN

San Lorenzo, CA

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The probability and amount of dust or dirt accumulation in a TV tuner depends as much on the amount of dust and moisture in the immediate area as on the age of the receiver. However, dusty or dirty contacts rarely affect only one channel. This condition usually causes erratic reception on all channels.

It is more probable that the symptom you describe is caused by an electrical or mechanical defect in the tuner or IF's.

Tuner problems can be difficult to diagnose. Not only do you have to determine whether the trouble is in the tuner or in the chassis, but, if it is in the tuner, you must determine whether it can be repaired profitably. An article titled "A Proper Approach to Tuner Repair" in the December issue of PF REPORTER provides practical information on tuner troubles and troubleshooting techniques.

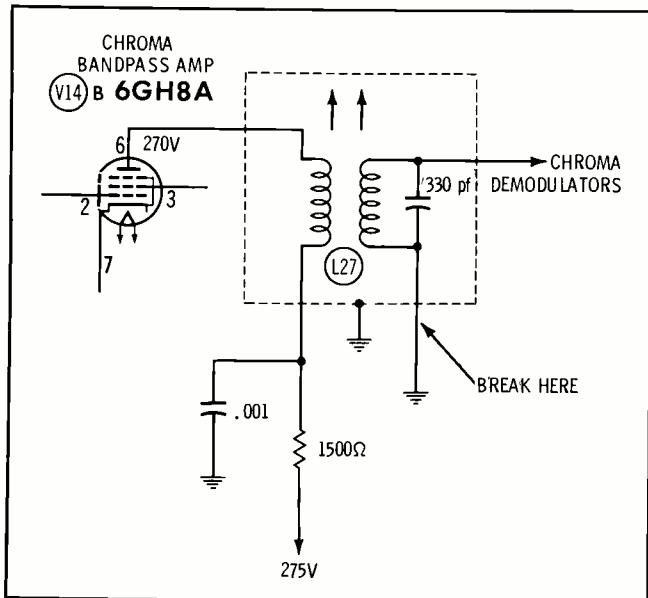
### Intermittent Color

An RCA CTC25X displayed color intermittently. During the periods when the set would not produce a normal color program, half-inch vertical color lines spaced an inch apart appeared across the entire screen. The lines did not drift or tear horizontally as with improper color sync.

The trouble was finally traced to an intermittent break in the ground lead of the secondary of the bandpass transformer, L27.

FRANK HASHINSKI

Delavan, WI



### Color CRT Troubles

We have recently encountered the following color picture tube troubles that could not be isolated with a CRT checker:

An RCA rectangular color picture tube had a multi-colored "dog ear" in the lower left corner of the screen. The "dog ear" could be removed only by misadjusting the purity. It was finally decided that the shadow mask was loose in the lower left portion of the tube. Installing a new picture tube cured the trouble.

(continued on next page)

# photofact<sup>TM</sup>bulletin

PHOTOFAC BULLETIN lists new PHOTOFAC coverage issued during the last month for new TV chassis. This is another way ELECTRONIC SERVICING brings you the very latest facts you need to keep fully informed between regular issues of PHOTOFAC Index Supplements issued in March, June, and September.

### GENERAL ELECTRIC

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### HITACHI

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### MOTOROLA

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### PRODUCTION CHANGE BULLETINS

### MOTOROLA (Color TV)

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### PACKARD BELL

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### ZENITH (Color TV)

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(continued from page 52)

The red and blue beams of another RCA rectangular CRT changed position as the tube warmed up over a period of 20 to 30 minutes. At first, it was suspected that a defect existed in the convergence panel, but no defect could be uncovered. After the set operated for 30 minutes, it was converged and retained perfect convergence until it was turned off. When it was turned on again the red and blue beams had shifted position. Replacing the CRT restored the receiver to normal operation.

A Zenith rectangular color picture tube could not be purified. The normal "red ball" could be observed only by pushing the yoke forward. (Normally it can be produced by pulling the yoke back against the convergence assembly.) When the yoke was pulled back, only partial purity could be obtained. Again, replacement of the CRT solved the problem.

The green gun of an RCA 19-inch color receiver could not be adjusted. Quickly turning down the green screen control would reduce the intensity of the green beam, but it gradually would return to full brightness. When the brightness control was turned down, the screen would turn green and bright retrace lines were displayed. The trouble was isolated to an open control grid in the green gun of the CRT.

All CRT troubles described here were finally isolated by substituting the receiver CRT with that of a color test jig.

B. T. STUBBS

Rosebud, TX



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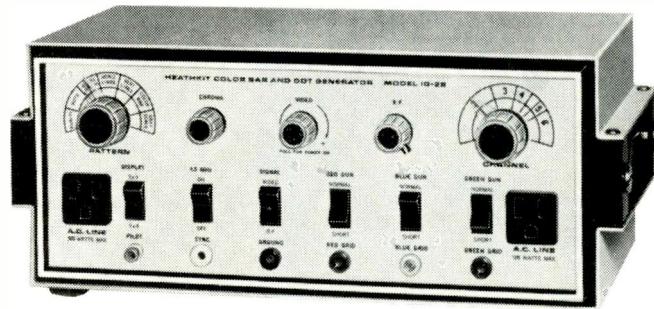
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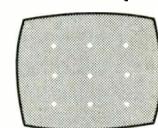
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**Advanced Design.** The new Heathkit IG-28 is one of the most stable, versatile Color and B&W TV service instruments available. In addition to the exclusive Heath "3 x 3" display of patterns illustrated, it also produces the familiar 9 x 9 displays . . . plus a clear raster for adjusting purity without upsetting the AGC. Fifteen J-K Flip-Flops count down from a crystal controlled oscillator to eliminate divider chain instability and adjustment.

**Time-Saving Versatility . . .** gives you front panel tuning for channels 2 thru 6 . . . front panel variable plus and minus video output . . . front panel sync output . . . two convenient AC outlets . . . built-in gun shorting circuits and grid jacks . . . vectorscope capability . . . crystal controlled sound carrier . . . banded transformer to eliminate stray fields . . . zener-regulated power supply . . . safe three-wire line cord . . . fast circuit board wiring harness assembly. For the versatility you couldn't get before . . . put the new IG-28 on your bench now.

Kit IG-28, 8 lbs.....\$79.95\*

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Please send my FREE 1969 Heathkit Catalog.

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TE-200

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# The Complete Line

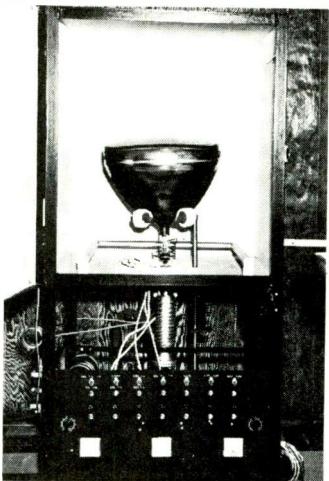
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*Circle 34 on literature card*

## product report

for further information on any of the following items, circle the associated number on the reader service card.

### Radio Control

(45)

Alliance Manufacturing Co., Inc. introduces a new solid-state radio control for the "Genie" automatic garage door opener systems.

Designated the "Genie AC-24", both the transmitter and receiver operates on a 24-volt power sup-

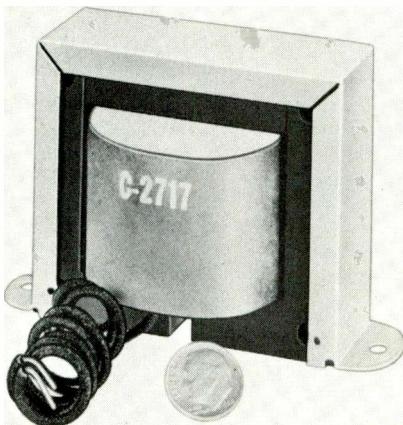


ply. The transmitter is a palm-sized push-button control supplied by a standard 9-volt battery. Normal operating range is within 100 feet.

The radio control system is priced at \$69.18.

### Smoothing Choke

(46)



A new multi-purpose Stancor smoothing choke is announced by Essex Wire Corporation.

The C-2717 reduces to the lowest possible level the ripple factor in

DC supply filters for electronic OEM's.

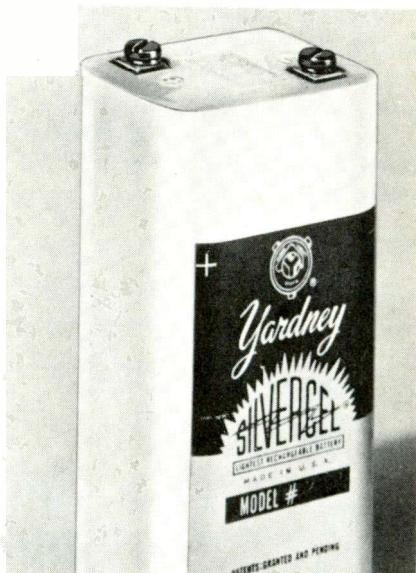
The unit incorporates Class "A" insulation and is rated 4 hys, 250 ma DC. It measures 2 5/8" x 4" x 2 1/8", weighs 2.4 lbs., and is priced at \$5.10.

### Rechargeable Battery

(47)

Yardney Electric Corp. has developed a powerful, lightweight, compact rechargeable battery available for industrial and commercial applications.

The new Silvercel<sup>®</sup> silver-zinc modular 4 1/2-volt battery has three cells. It has a five ampere hour nominal capacity and will provide 45 watt hours per pound as compared to 10-15 watt hours for nickel-cad-



mium, and 8-12 watt hours for a lead-acid.

The batteries range in price from \$20 to \$30.

### Single Channel Pre-Amplifier

(48)

Solid-state single channel all silicon antenna pre-amplifiers are now available from the Finney Company.

The five models, M-13 to M-18, have a low-band gain of 30 dB and a high-band gain of 20 dB; a low-band noise figure of 3.5 dB and a high-band noise figure of 4.5 dB.

They are designed to fit on the antenna boom close to the terminals of the antenna to take advantage of maximum signal and minimum noise condition. Pre-drilled stainless steel straps are supplied to connect antenna and amplifier input termi-

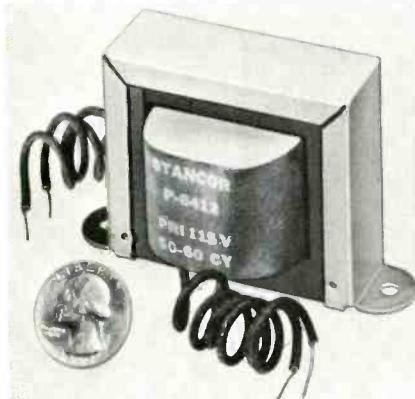


nals making permanent connection of fixed impedance.

The units, remotely powered by an indoor power supply, are available in a choice of 300 ohm and 75 ohm inputs and outputs for FM bands as well as for VHF channels. The prices range from \$77.50 to \$102.00.

#### **Isolation Transformer (49)**

**Essex Wire Corporation** introduces the Stancor transformer, engineered for isolating electrical circuits or equipments from a 115-



volt power source.

The P-6412 has been designed for low power losses plus high efficiencies, and features electrostatic shielding grounded to the transformer core.

The unit is rated at 35 watts, 115 volts/116 volts, 50/60 Hz; measures 2 3/8" x 2 1/8" x 3 3/4"; and is priced at \$5.16.



Are you about to give away \$25.00 worth of free labor? Are you sure enough to go through dismantling the complete color CRT assembly, reinstallation, purity and convergence to find that the color CRT wasn't really bad — or that you couldn't get credit from your distributor? Is this good business? With up to a 3-year warranty you could get hurt without a proper test.

# **YOU CAN BE SURE!**



The CR143 Champion has become the standard of the electronics industry. It checks them all, large or small, black or white. Color CRTs are tested just like they are in the CRT factory; one gun is automatically compared against the others. This factor has been proclaimed by all CRT manufacturers as most important — and credit is often issued on that basis. Only the CR143 Champion has three G2 controls just like in the color set and therefore is the only tester that can compare the color guns automatically. Many CRT manufacturers use the Champion in their own plants. Why waste the day? Go all the way with the industry standard. You can be sure. **\$119.50**



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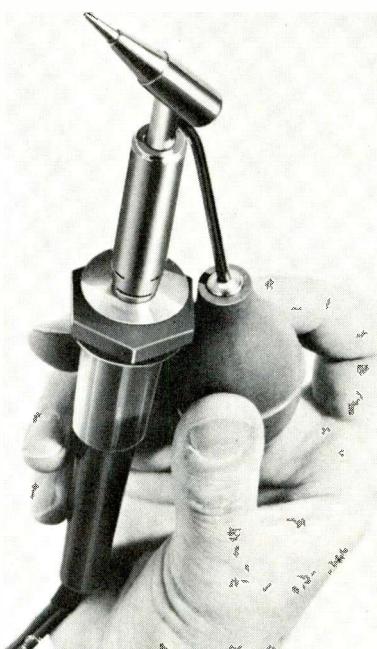
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60000 KUNSTMAN  
WASHINGTON, MICH. 48094

Circle 36 on literature card

## product report

(continued)

### De-Soldering Tool (50)



American Beauty introduces a new miniature de-soldering tool consisting of a hollow tip which

surrounds the connection, melts the solder and vacuums the work clean.

Known as No. 495, the tool is designed for use with the company's Little Dandy Soldering Iron No. 3112.

The outfit is available in 40, 50 or 60-watt capacity. Tips are interchangeable and come in an aperture choice of 0.03", 0.04", 0.05" or 0.06". All parts are replaceable.

The price is \$6.95. Model No. 490, complete with handle, is \$12.10.

### Antenna Mount (51)

**South River Metal Products Co., Inc.** announces a new single-assembly unit, roof-top antenna mount, Model #TRM. The unit opens like an umbrella with no loose parts to assemble. The tubular steel bracing members that support the integral antenna mast are made of heavy gauge, welded seam, hot-dip galvanized steel tubing, and are position-fixed with a wing nut.

The antenna mast is 5' x 1 1/4" and is made of rustproof, hot-dip galvanized steel available in 2 gauge thickness.

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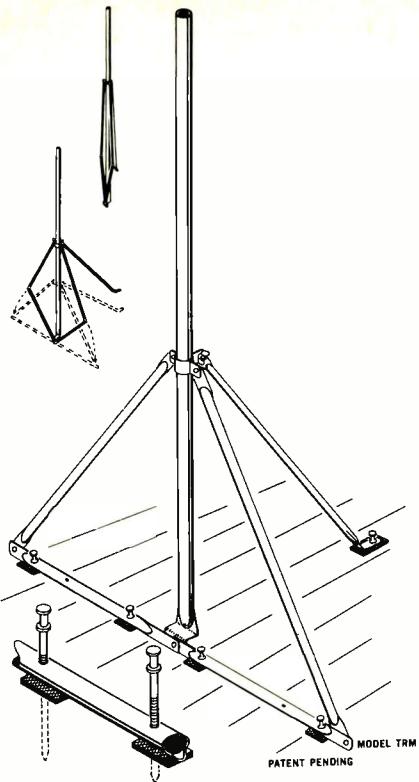
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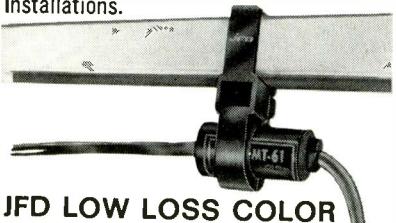
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# What Makes COAX CONDUCT?



Coax is a very efficient transmission line, but few technicians really understand how it conducts TV signals. Signals don't simply go down to the set through the center conductor and back up to the antenna on the shield as many believe. Instead, TV signals travel through the center conductor via a series of magnetic build-ups and collapses, or "incident waves."

Two things determine the quality of coax: (1) the match; and (2) the attenuation or loss it causes. If the center conductor is not really in the center of the dielectric at all points along the cable, match is poor. And poor match causes color smears. The loss of a cable is determined by the size of the center conductor and the type of dielectric used. Low loss is an especially important factor in 82-channel installations.



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## bookreview

**Closed-Circuit TV for Engineers and Technicians:** Leonard C. Shewalter, Howard W. Sams & Co., Inc., Indianapolis, IN, 1969; 272 pages, 5 1/8" x 8 1/8", hardbound, \$8.95. (Catalog Number 20606.)

Intended both as a reference and a textbook for those who operate, maintain and design closed-circuit television systems, this text provides practical knowledge of TV systems, system components, supporting equipment, lighting, optics, recording, and testing and maintenance. Installation methods also are discussed.

**Advanced Techniques for Troubleshooting with the Oscilloscope:** Robert L. Goodman, TAB Books, Blue Ridge Summit, PA, 1969; 256 pages, 5 1/8" x 8 1/8", hardbound, \$7.95; paperbound, \$4.95.

This text provides a detailed discussion of the operation and applications of modern oscilloscopes, including triggered-sweep, dual-trace and DC types.

Chapters 1 through 4 analyze the circuit operation, characteristics and control adjustments of specific types of scopes. Interpreting waveforms is the topic of Chapter 5.

Troubleshooting technique and alignment procedures using the scope in stereo amplifiers, multiplex FM, solid-state TV, color TV, TV remote controls and power supplies are provided in Chapters 6 through 11.

Although emphasis is placed throughout the text on the use of triggered-sweep, DC scopes, most of the troubleshooting procedures outlined can be performed with a standard service scope. ▲

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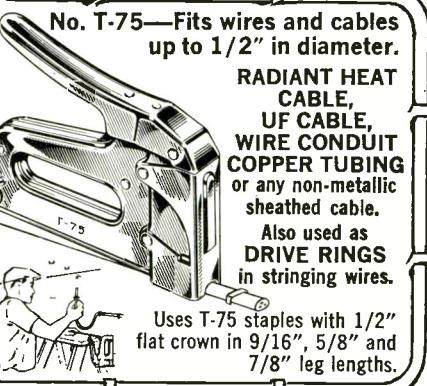
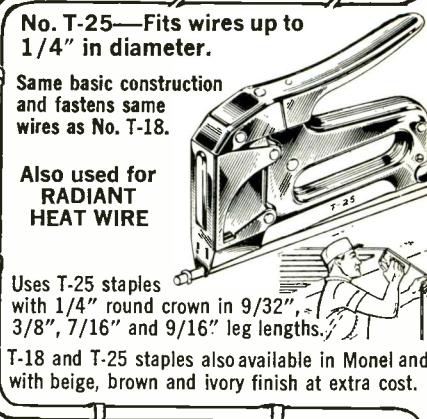
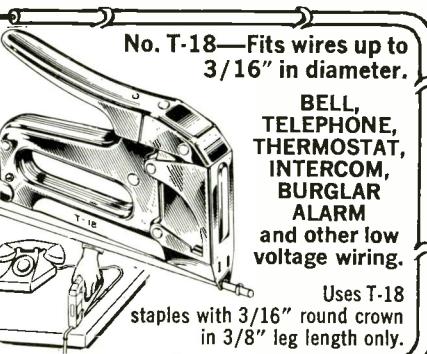
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# catalogs literature

## ANTENNAS

100. *Jerrold*—37-page specification guide, No. 5319-102, describes step-by-step procedures for planning MATV systems.

101. *RMS Electronics*—Specification sheet lists and illustrates all RMS Hybrid splitters and UHF-VHF tap-offs.

## AUDIO

102. *Robins Industries*—24-page consumer catalog No. C6900 has information on magnetic recording tape and audio accessories to be passed out to customers.

## COMPONENTS

103. *ALCO*—8-page catalog includes the expanded line of miniature switches, keyboard switches and push button modules.

104. *Oak Electro/Netics*—Hart /Advance Relay Div. offers 36-page catalog/hand-power, RF and signal relays.

105. *Russell Industries*—Selector chart gives exact requirements (type, body and shaft hole diameter, body style, etc.) for various control knobs.

## SPECIAL EQUIPMENT

106. *GBC Closed Circuit TV*—Catalog lists available closed circuit TV cameras and accessories with technical information and prices.

107. *Power/Mate*—8-page catalog describes the UniPower series of power supplies with electrical specifications, mechanical data and prices.

## TECHNICAL PUBLICATIONS

108. *Howard W. Sams*—Literature describes popular and

informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including 1969 catalog of technical books on every phase of electronics.\*

109. *TAB Books*—Spring, 1969 catalog describes over 100 current and forthcoming books including Broadcasting, basic technology, CATV, television radio and electronics servicing.

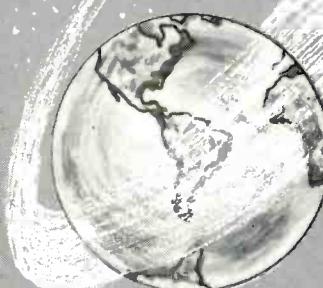
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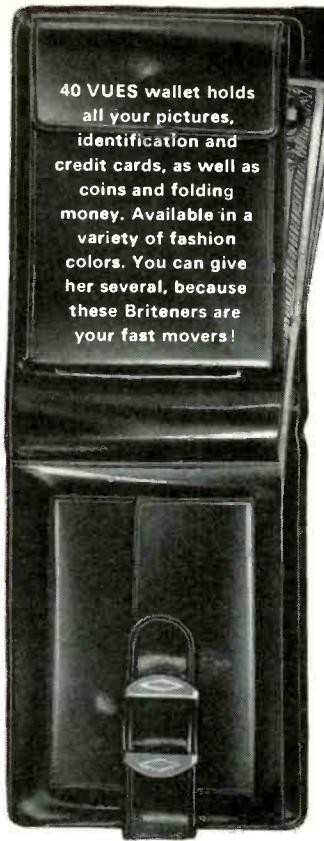


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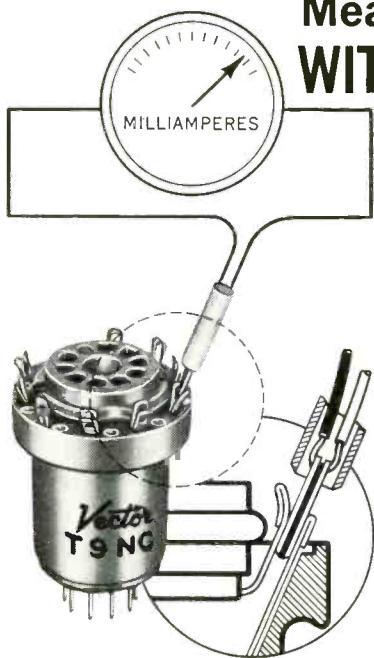
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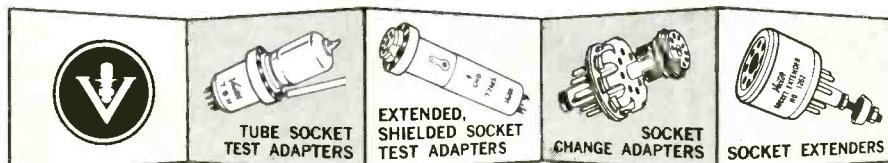
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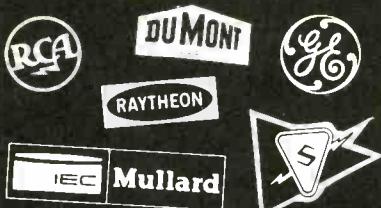


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# Why do service technicians specify RCA color picture tubes more often than any other brand?



Back in the early days of color, you had no choice. Now that you have a choice, it's still RCA by a wide preference. Why? Primarily because of experience.

And hand-in-glove with experience goes performance. Outstanding overall performance...

down through the years...with a wide variety of tube sizes.

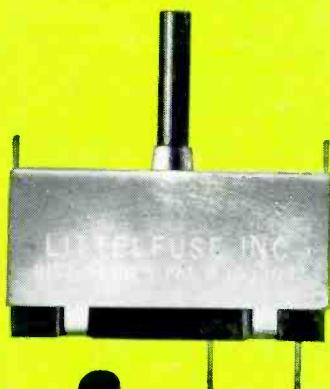
Put them together and they add up to confidence...for the service technician who installs the tube...for the set owner who has to pay the bill.

RCA puts its reputation on the line with every picture tube it makes. Whether it's the RCA HI-LITE built to OEM specs all the way...or a quality rebuilt RCA Colorama...you can rely on RCA picture tubes to protect your hard earned service reputation. They're designed to protect the biggest reputation in the COLOR TV industry.

RCA Electronic Components, Harrison, N.J.

**RCA**

# Give yourself a break you can depend on!



actual size  
1 1/4" x 1 3/16" x 1/2"



CIRCUIT BREAKER CADDY

10 ratings, one each 2-1/4,  
2-1/2, 2-3/4, 3, 3-1/4, 4,  
4-1/2, 5, 6 and 7 amps.



SERVICE CADDY  
Breakers and Fuses

One service call is all  
—8 breakers—one rating  
each 2-1/4, 2-3/4, 3, 3-1/4,  
4, 4-1/2, 5 and 7 amps and  
30 fuses—five each type C3/10,  
C1/2, C3-1/2, N3/10, N7/10 and N1.



Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for all types of electronic and electrical control wiring such as model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines and small fractional horsepower motors.

Available individually packaged one breaker per display card; or 5 breakers of same rating per unit pack or as complete, versatile assortments for shop use or replacements in the field.

Included with each assortment:

Pocket size cross reference on color and black/white TV circuit breaker applications.  
Form No. CBCRP-1266H

# LITTELFUSE

DES PLAINES, ILLINOIS

Circle 45 on literature card